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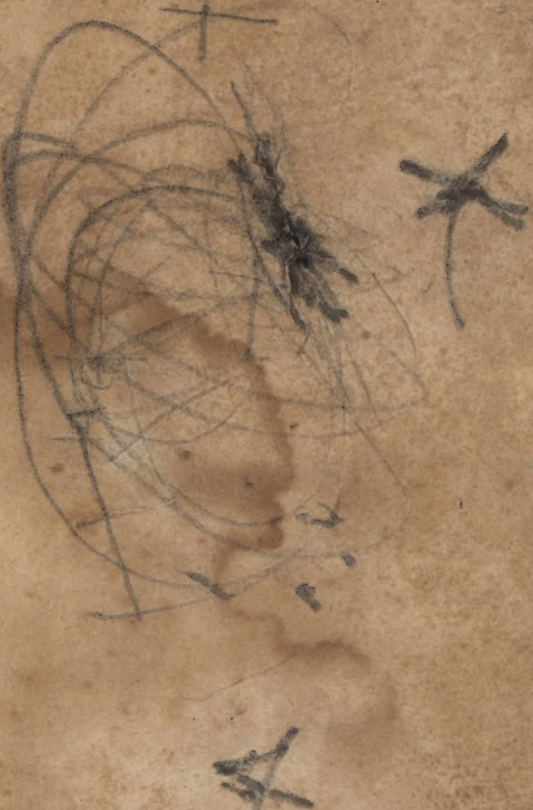

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THE ARCANA OF ARTS AND SCIENCES,

OR,

FARMERS' & MECHANICS'

MANUAL;

CONTAINING A GREAT VARIETY OF

VALUABLE RECEIPTS AND USEFUL DISCOVERIES,

IN THE VARIOUS DEPARTMENTS OF HUMAN KNOWLEDGE;

MANY OF WHICH WERE

NEVER BEFORE PUBLISHED.

By DR. M. PARKER.

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WASHINGTON, PA.

PRINTED BY J. GRAYSON—A. D. 1824.

TO THE

CITIZENS

OF THE

WESTERN COUNTRY,

The following Pages are most respectfully

DEDICATED,

By their Obed't. Serv't.

THE PROPRIETOR.

CONTENTS.

STAINING WOOD, &c.

JEWELLERS' SECRETS.

VARIOUS RECEIPTS.

PREFACE.

WHEN it is considered how numerous and various are the publications which are daily issuing from the press, and how few of them are generally read by the great body of the people, or are calculated to promote their interest or happiness; it is to be expected that he who adds to the number should be able to assign substantial reasons for introducing a new work to the notice of the public. The most numerous as well as the most useful part of the community, are those employed in agriculture and manufactures. Though the generality of these classes are not opulent enough to purchase large libraries, nor have they sufficient leisure to peruse large publications if within their reach; nevertheless they are capable of deriving much useful information from the writings of scientific men, if they knew where to obtain what was really beneficial in their several avocations without great labor and expense. To render such information attainable by the practical farmer and mechanic, in an easy

and economical manner, is the object of the present work; and the editor trusts that it will be found worthy a share of public patronage. It is unquestionably the true policy of the people of the U. States to foster and encourage every effort to promote national industry, as the only sure way of increasing the wealth and securing the independence of our country. Blessed as we are with almost every variety of soil and climate, living in a country where the land produces abundantly, and where raw materials for nearly all the necessary manufactures can be obtained, we confidently look forward with fond anticipation to the time when we shall be able to supply ourselves with all the necessaries of life; and every true American will admit, that that which can be produced on as good terms at home, ought not to be brought from abroad. The more abundant our productions are at home, as respects the produce of the field and the labor of the hand, the greater will be our prosperity and independence, and the less necessity of reliance on foreign nations.—Hence, every thing which is calculated to increase the former, with less toil, or the latter with less expense, is certainly an object worthy of encouragement by the American

people. Little need be said to shew the general utility of a work of this nature—the matter itself being a sufficient apology for introducing it to the notice of the public. On inspecting the table of contents, the reader will perceive that the subjects treated of are evidently of the utmost importance to those for whom the work is principally intended; and on perusal of its contents, it is presumed it will be no less apparent that the editor has collected a body of valuable information on each of those subjects, and notwithstanding the great variety of them, each will be found full and complete, much more so than so small a work could at first seem to promise. In the various departments of science the author has made free use of the encyclopædia of the learned Dr. Rees and other works of the first order, though a considerable portion of this work is original. The instructions here offered are most of them the result of actual experiment, and may therefore be confidently relied upon as exhibiting the latest improvements in many important branches of arts and sciences. It has been a source of much complaint, that various publications have been palmed upon the people, purporting to contain valu-

able secrets in arts and trades, &c. which, however plausible in theory, are too expensive to reduce to practice; nor are they the result of experience—many of them mere fiction. The editor feels confident that the present work will not be found liable to such objections, as he has studied economy and endeavored to discover the cheapest and best method to accomplish the desired end. The author cannot flatter himself that every subject contained in this book will be of importance to all readers; yet he feels assured that there are many subjects which will be interesting and profitable to every family, by enabling them to carry on their domestic manufactures to the best advantage, which alone will more than compensate for the cost of the work. During several years residence in the western part of Pennsylvania, the editor has been much gratified to observe the regular and progressive improvements made in agriculture, manufactures, and the mechanical arts, and he trusts that this publication, if extensively known, will contribute in no small degree to their further advancement; and while he expresses his gratitude to the public for the liberal patronage he has received, he concludes with

the hope that the advantages which will be derived from it will be many and permanent, considering what a body of useful information, derived from numerous and expensive sources, is presented to the public in a cheap and concise form. The editor therefore submits it with confidence, not doubting but it will meet with a favorable reception among the liberal and industrious of his fellow-citizens.

ARCANA

OF

ARTS AND SCIENCES.

AGRICULTURE.

AGRICULTURE, being a science on which the preservation and happiness of society chiefly depends—it being the stamina of its existence, too much cannot be done to render it productive, to correct the morbidity of the soil, and prepare the various kinds of seed necessary for so useful a science.

I have therefore selected the best and most approved methods for the culture of Wheat, Rye, Barley, Oats, Indian Corn, Buckwheat, and Potatoes, together with Flax and Hemp, the various and most profitable kinds of Grass, with the best methods of preventing the devastation caused by flies, grubs, cutworms, and weevils, with the best methods of preparing the ground for seeding.

AGRICULTURE claims a pre-eminence above manufactures and commerce, from its seniority and superior usefulness; and may be regarded as the breasts from which the human family derive their support and nourishment.

Manufactures and commerce originally owed their existence to agriculture; and the people in carrying them on, must constantly be fed by those who are engaged in the parent art. Agriculture may, therefore, be considered as of the first importance to mankind; because their temporal welfare and prosperity depends

upon receiving a regular and sufficient supply of all the articles cultivated by the agriculturist. In an age like the present, when the utility of agriculture is so fully recognised, it is not necessary to dwell at length upon the advantages which every individual, we may say every nation, must enjoy, when that art is sufficiently understood and skilfully practised.

The theory of agriculture which is herein laid down, is built upon the following fundamental principles; and with one or other of them, every part of rural practice is more or less combined.

First—That the soil be kept dry, or, in other words, free of all superfluous moisture. Secondly—That it ought to be kept clean, or, in other words, free of noxious weeds. Thirdly— That it ought to be kept rich, or, in other words, that every particle of manure, which can be collected, ought to be applied, so that the soil may be kept in a state capable of yielding good crops. Every person, possessed of a sufficient capital stock, may act according to the first and second principles; but it is only where local circumstances are favorable, that the last can be carried completely into effect—no more, however, being required of the farmer, than that he shall make the most of his situation.

In the first place the utility, nay, the necessity of keeping land dry and preserving it from being inundated or flooded with water, is so obvious, that few arguments will be required in support of this primary principle. When land is allowed to remain in a state of wetness, which may either be occasioned by spouts or springs in the under soil, or by rain water stagnating on the surface, the earth gets into a sour state, which afterwards is detrimental to the growth of plants, and often, in the first instance, prevents either ploughing or harrowing from being successfully effected. Under such circumstances, the young plants, either of corn or grass, become yellow and sickly, and never assume that thriving, vigorous aspect, which they maintain upon fields differently circumstanced. Besides, manure has not the same effect when the earth is drowned, or even injured with wetness, as when it is kept dry and free from superfluous moisture. Under-draining is the only

method of correcting the evils arising from spouts or springs; and digging out the head-land and gutter-furrows, the only preventative against surface water, when heavy falls of rain or snow storms ensue. In fact, without attention to these important operations, arable land can neither be well managed, nor full crops reaped. Perhaps the goodness or badness of farm management may be as correctly estimated by the attention shown to draining, as by any other mark whatever. Where draining is neglected, a sure proof is furnished that many other branches of the art are imperfectly executed. Unless this branch of rural economy is assiduously attended to, the advantages arising from ploughing and manuring are only partially obtained.

In the second place, the benefit arising from keeping the land clean, is sufficiently discernible: weeds, whether of the annual or perennial kind, may be regarded as preferable creditors of the soil, who will reap the first advantage of manure, if allowed to remain in possession: their removal, therefore, forms an important object of the husbandman's attention. It may be stated that, according to the degree of success that follows the means employed, so will the goodness or badness of the husbandman's crops be regulated. If the strength or nutritive powers of the soil be exhausted, or drawn forth by weeds, or such plants as the soil naturally produces, it is impossible that artificial plants can prosper.

In the third place, the necessity of restoring to the soil, in the shape of manure, the powers drawn from it by artificial crops, is acknowledged by almost every person. Manure, in fact, is the most powerful agent in the hands of the farmer, and the attention bestowed upon collecting, preparing, and applying it, constitutes an important branch of the art which he practises. Perhaps agriculturists are more behind, in this third general principle, than in the others.

These three fundamental principles must hang or fall together. Without laying land dry, neither the advantages of good ploughing, nor the benefits arising from manure, can be fully obtained. When any of the other principles are neglected, similar defects will necessarily ensue; but when they are all acted upon,

and the land is kept dry, clean, and in good heart, the husbandman may expect a suitable reward for the trouble and expense bestowed on its cultivation. An agricultural code of this kind is not only a true one, but has the peculiar merit of being simple and distinct; and were it carried into execution; were the operations of farmers regulated by its tenets; were their endeavors constantly directed to keep the lands in their possession dry and clean, and as rich as possible, then the country would progressively improve.

On Soils.

Soil, strictly speaking, is the ground or earth wherein crops of every kind are produced, and is noticed in this way merely to distinguish the surface from the under stratum, or subsoil, on which the surface is incumbent. The value or worth of that part of the earth, which is the object of cultivation, depends materially upon the nature of the under stratum; because, when the latter is close or extremely retentive of moisture, the expense and hazard of cultivating the surface is considerably increased, whilst the growth of plants, cultivated upon it, is much impeded, particularly in adverse seasons.

The names which different agriculturists have adopted with regard to soils, being variable and indistinct, it is a difficult task to describe them, or to mark, with any degree of accuracy, the shades which distinguish one from another, so nearly are many of them connected: generally speaking, the component parts of soil, whatever may be the color, are argil, silex or sand, water, and air, for into these original principles may all earths be reduced, however blended with apparently foreign substances. Argil is the soft and unctious part of clay. The primitive earths, argil and sand, contain each, perhaps in nearly equal degrees, the food of plants; but in their union the purposes of vegetation are most completely answered The precise quantities of each, necessary to make this union perfect, and whether they ought to be equal, it is neither very easy, nor very material to ascertain, since that point is best determined in practice. When the soil proves to be neither too

stiff or adhesive, from the superabundance of clay, nor of too loose and weak a texture, from an over quantity of sand in its composition, the medium is undoubtedly the best; but an excess towards adhesion is obviously most safe. A stiff or strong soil holds the water which falls upon it for a long time, and being capable of much ploughing, is naturally well qualified for bearing crops which strike a deep root. A light soil, or one of a texture feeble and easily broken, is, on the contrary, soon exhausted by ploughing, and requires renovation by grass, otherwise it cannot be cultivated to advantage.—Soils may be considered and characterized, as far at least as is necessary for practical purposes, under the distinctions of clayey, loamy, chalky, sandy, gravelly, and peaty or mossy. Each of these diversities, of course, comprehends several varieties, according to the nature and preponderance of the different sorts of materials of which they are composed.

Loam has generally been considered as an original earth, though it may more properly be denominated an artificial soil, produced by calcareous matters and animal and vegetable manures. The strongest clay may, in process of time, be converted into a loam by repeated applications of these substances, and the richness or freeness of that loam will depend entirely upon the quantity of manure with which it has been supplied. Sandy soils may also be converted into light loams by the application of lime, chalk, marl, and especially clay; even peat may be converted into a black soft loam, and in various ways rendered fertile and productive. From these circumstances, a degree of confusion prevails respecting the nature and properties of soils, which renders the subject more difficult than at first sight might be expected. Even the admixture of surface and subsoil, by deep ploughing, creates a change of considerable magnitude.

A clay soil, though distinguished by the color which it bears, namely: black, white, yellow and red, differs from all other soils, being tough, wet and cold, and consequently requiring a good deal of labor before it can be sufficiently pulverized, or placed in a fit state for bearing artificial crops of corn or grass. Clay land is

known by these qualities or properties. It holds water like a cup, and once wet, it does not soon dry. In like manner, when thoroughly dry, it is not soon wet. In a dry summer, clay cracks, and shews a surface full of small chinks or openings: if ploughed in a wet state, it sticks to the plough like mortar; and in a dry summer the plough turns it up in clods, scarcely to be broken or separated by the heaviest roller.

Sandy soils next come under consideration: soils of this description are managed with infinitely less trouble, and at an expense greatly inferior to what clays require; but at the same time the crops produced from them are generally of smaller value. There are many varieties of sand, however, as well as of clay, and in some places the surface is little better than a barren sand, wherein artificial plants will not take root, unless a mixture of clay or good earth is previously administered. This is not the soil meant by the farmer when he speaks of sands. To speak practically, the soil meant is one where sand is predominant, although there be several other earths in the mixture. From containing a great quantity of sand, these soils are all loose and crumbling, and never get into a clod, even in the driest weather: this is the great distinction between sands and sandy loams. A sandy loam, owing to the clay that is in it, does not crumble down, or become loose like real sand, but retains a degree of adhesion after wetness, or drought, notwithstanding the quantity of sand that is mixed with it. Perhaps a true sandy loam, incumbent upon a sound subsoil, is the most valuable of all soils, upon which every kind of grain may be raised with advantage; and no soil is better calculated for turnips and grass.

The real sands are not favorable to the growth of wheat, unless preceded by clover, which binds the surface, and confers a temporary strength for sustaining that grain.

I have now to speak of gravelly soils. The open or porous nature of these soils disposes them to imbibe moisture, and to part with it with great facility: from the latter circumstance, they are subject to burn, as it is termed, in dry seasons. The main difference between

gravel and sand is, that the former is chiefly composed of small soft stones, though, in some instances, the stones are of the silicious or flinty nature; and, in others, of the calcareous and chalky From these constitutional circumstances arises the propriety of deepening gravelly soils by coats of marl or earth, and of keeping them fresh by frequent returns of grass and repeated application of manure. Gravelly soils, from the lightness of their texture, are not expensive, or difficult in the means of cultivation. All the necessary business required for gravels, may be carried forward with ease and expedition; and such soils are, in general, soon brought into a proper state for the reception of crops.

From what has been said respecting gravels, it will appear that, naturally, they are barren, unless when mixed with other earths; and that the surface of most of them would exhibit the same appearance as the subsoil, or what is beyond the reach of the plough, were it not changed and meliorated by vegetable matters. The constitutional qualities of gravels, also point out the propriety of ploughing them deep, so that the surface soil may be augmented, and greater room given to the growth of the plants cultivated on them. A shallow ploughed gravel can stand no excess of weather, however enriched by manure: it is burned up by a day or two of drought, and it is almost equally injured by an excessive fall of rain, unless the pan, or firm bottom, which such soils easily gain, be frequently broken through by deep ploughing. According to an old adage, the top of clay, and the bottom of gravel, are best; but though we cannot subscribe to the first part of the adage, being satisfied that deep ploughing is highly beneficial, except where the subsoil is of a poisonous nature, we are certain that the latter is well founded, and ought never to be overlooked.

Peat earth, or moss, is the next kind of soil which is to be treated of; though it is very uncertain whether, like loam and garden mould, it ought not to be viewed as an artificial soil, produced by certain substances deposited on the surface of the earth, and not one originally created, or to be found in the early ages. Satisfactory accounts concerning the formation of moss, the uses to

which it may be applied, and the means of removing it, have not yet been discovered.

Soils, therefore, differ considerably from each other, according to the proportions of the different earths of which they consist. To determine what are the requisites which distinguish or constitute arable or fruitful soils, is of much importance to the farmer, since vegetable substances evidently imbibe from the earth and surrounding atmosphere the principle of oils, mucilage and other peculiar products, only found in organized substances; it can hardly be doubted but that manure, or the remains of decayed substances, render lands fruitful by supplying these materials ready formed. What remarks are offered on the subject of manure, will be found under that head. I shall now offer the following additional observations, which are drawn principally from analytical investigation.

When a barren soil is examined with a view to its improvement, it ought in all cases, if possible, to be compared with an extremely fertile soil in the same neighborhood, and in a similar situation; the difference given by their analyses would indicate the methods of cultivation, and thus the plan of improvement would be founded upon accurate scientific principles. If the fertile soil contained a large quantity of sand, in proportion to the barren soil, the process of melioration would depend simply upon a supply of this substance, and the method would be equally simple with regard to soils deficient in clay or calcareous matter.

In the application of clay, sand, loam, marl, or chalk to lands, there are no particular chymical principles to be observed; but when quicklime is used great care must be taken that it is not obtained from the magnesian limestone; for in this case it is exceedingly injurious to land. The magnesian limestone may be distinguished from the common limestone by its greater hardness.

When the analytical comparison indicates an excess of vegetable matter, as the cause of sterility, it may be destroyed by much pulverization and exposure to air, by paring and burning, or the agency of lately made quicklime. And the defect of animal and vegetable matter must be supplied by animal or vegetable matter.

The general indications of fertility and barrenness must necessarily differ in different climates, and under different circumstances. The power of soils to absorb moisture, a principle essential to their productiveness, ought to be much greater in warm and dry countries, than in cold and moist ones; and the quantity of fine aluminous earth they contain should be larger. Soils, likewise, that are situated on declivities, ought to be more absorbent than those in the same climate in plains or in valleys.

The productiveness of soils must likewise be influenced by the nature of the subsoil, or the earthy or stony strata on which they rest: thus, a sandy soil may owe its fertility to the power of the subsoil to retain water; and an absorbent clayey soil may occasionally be prevented from being barren, in a moist climate, by the influence of a sub-stratum of sand or gravel. Those soils that are most productive of corn, contain always certain proportions of aluminous earth in a finely divided state, and a certain quantity of vegetable or animal matter. The quantity of calcareous earth is, however, very various, and in some cases exceedingly small. In some experiments made on the composition of soils at Paris, it was found, that a soil composed of three-eighths of clay, two eighths of river sand, and three-eighths of the parings of limestone, was very proper for wheat.—In general, bulbous roots require a soil much more sandy and less absorbent than the grasses.

Plants and trees, the roots of which are fibrous and hard, and capable of penetrating deep into the earth, will vegetate to advantage in almost all common soils that are moderately dry, and do not contain a very great excess of vegetable matter.

From the great difference of the causes that influence the productiveness of lands, it is obvious, that in the present state of science, no certain system can be devised for their improvement; but there are but few cases in which the labor of analytical trials will not be amply repaid by the certainty with which they denote the best methods of melioration; and this will particularly happen, when the defects of composition is found in the proportions of the primitive earths.

In supplying animal or vegetable manure, a temporary food only is provided for plants, which is in all cases exhausted by means of a certain number of crops; but when a soil is rendered of the best possible constitution with regard to its earthy parts, its fertility may be considered as permanently established: it becomes capable of attracting a very large portion of vegetable nourishment from the atmosphere, and of producing its crops with comparatively little labor and expense.

Under the head of mineral analysis, nothing is of so much general importance as the examination of soils, with a view to the improvement of such as are less productive, by supplying the ingredients they want, in due proportions, to increase their fertility. An account of the methods to be pursued shall be stated in due course, as follows:—

The substances found in soils are certain mixtures or combinations of some of the primitive earths, or animal and vegetable matter in a decomposing state, certain saline compounds and the oxide of iron: these bodies always retain water, and exist in very different proportions in different lands, and the end of analytical experiments is the detection of their quantities and mode of union.

The earths commonly found in soils are principally silex, or the earth of flints; alumine, or the pure matter of clay; lime, or calcareous earth; and magnesia. Silex composes a considerable part of hard gravelly soils, hard sandy soils, and hard stony lands. Alumine abounds most in clayey soils and clayey loams; but even in the smallest particles of these soils, it is generally united with silex and oxide of iron. Lime always exists in soils in a state of combination, and chiefly with carbonic acid, when it is called *carbonate of lime.* This carbonate, in its *hardest* state, is *marble;* in its *softest*, *chalk.* Lime, united with *sulphuric acid*, is *sulphat of lime*, or *gypsum;* with *phosphoric acid*, *phosphat of lime*, or the earth of bones. Carbonate of lime, mixed with other substances, compose chalky soils and marls, and is found in soft sandy soils. Magnesia is rarely found in soils—when it is, it is combined with *carbonic acid*, or with *silex* and *alumine.* Animal decomposing

matter exists in different states, contains much carbonaceous substance, volatile alkali, inflammable aeriform products, and carbonic acid: it is found chiefly in lands lately manured. Vegetable decomposing matter usually contains still more carbonaceous substance, and differs from the preceding principally in not producing volatile alkali: it forms a great proportion of all peats, abounds in rich mould, and is found in larger or smaller quantities in all lands. The saline compounds are few, and in small quantity; they are chiefly *muriate of soda*, or common *salt; sulphat of magnesia; muriate* and *sulphat of potash; nitrate of lime*, and the mild alkalis; *oxide of iron*, (which is the rust produced by exposing iron to air and water,) is found in all soils, but most abundantly in red and yellow clays, and red and yellow sands.

The instruments requisite for the analysis of soils are few: A pair of scales, capable of holding a quarter of a pound of common soil, and turning with a single grain when loaded; a set of weights, from a quarter of a pound Troy, to a grain; a wire sieve, coarse enough to let a pepper-corn pass through; an Argand lamp and stand; a few glass bottles; Hessian crucibles; and China or queensware evaporating basins, a Wedgwood pestle and mortar; some filters, made of half a sheet of blotting paper, folded so as to contain a pint of liquid and greased at the edges; a bone knife; and an apparatus for collecting and measuring aeriform fluids.

The regents necessary are muriatic acid; sulphuric acid; pure volatile alkali, dissolved in water; solution of prussiate of potash; soap ley, and solutions of carbonate of ammonia; muriate of ammonia; neutral carbonate of potash, and nitrate of ammonia.

When the general nature of the soil of a field is to be ascertained, specimens of it should be taken from different places, two or three inches below the surface, and examined as to the similarity of their properties. It sometimes happens, that on plains, the whole of the upper stratum of land is of the same kind; and in this case, one analysis will be sufficient. But in valleys, and near the beds of rivers, there are very great differences; and it now and then occurs that one part of a field is

calcareous and another part silicious; and in this and analogous cases, the portions different from each other should be analysed separately. Soils when collected, if they cannot be examined immediately, should be preserved in phials quite filled with them, and closed with ground glass stoppers. The most convenient quantity for a perfect analysis, is from two hundred grains to four hundred. It should be collected in dry weather, and exposed to the air till it feels dry. Its specific gravity may be ascertained by introducing into a phial, which will contain a known quantity of water, equal *quantities*, say equal bulks of water and of the soil, which may easily be done by pouring in water till the phial is half full, and then adding the soil till the fluid rises to the mouth. The difference between the water and that of the soil will give the result. Then, if the bottle will contain four hundred grains of water, and gains two hundred grains when half filled with water and half with soil, the specific gravity of the soil will be 2, that is, it will be twice as heavy as the water; and if it gained one hundred and sixty-five grains, its specific gravity would be 1825; water being 1000. It is of importance that the specific gravity of a soil should be known, as it affords an indication of the quantity of animal and vegetable matter it contains; these substances being always most abundant in the lighter soils. The other physical properties of soils, should likewise be examined before the analysis is made, as they denote, to a certain extent, their composition, and serve as guides in directing the experiments: thus, silicious soils are generally rough to the touch, and scratch glass when rubbed upon it; aluminous soils adhere strongly to the tongue, and emit a strong earthy smell when breathed upon; and calcareous soils are soft, and much less adhesive than aluminous soils.

2. Soils, when as dry as they can be made by exposure to the air, still retain a considerable quantity of water, which adheres with great obstinacy to them, and cannot be drawn off without considerable heat; and the first process of analysing is to free them from as much of this water as possible, without affecting their composition in other respects: this may be done by

heating the soil for ten or twelve minutes in a china basin over an Argand lamp, at a temperature equal to 300° of Fahrenheit; and if a thermometer be not used, the proper degree of heat may easily be ascertained by keeping a piece of wood in the basin in contact with its bottom; for as long as the color of the wood remains unaltered, the heat is not too high; but as soon as the wood begins to be charred the process must be stopped: the loss of weight in this process must be carefully noted, and if it amount to 50 grains in 400 of the soil, this may be considered as in the greatest degree absorbent and retentive of moisture, and will generally be found to contain a large proportion of aluminous earth: if the loss be not more than 10 or 20 grains, the land may be considered as slightly absorbent and retentive, and the silicious earth as most abundant.

3. None of the loose stones, gravel, or large vegetable fibres, should be separated from the soil, till the water is thus expelled, for these bodies are often highly absorbent and retentive, and consequently influence the fertility of the land. But after the soil has been heated as above, these should be separated by the sieve, after the soil has been gently bruised in a mortar. The weight of the vegetable fibres or wood, and of the gravel and stones, should be separately noted down, and the nature of the latter ascertained. If they be calcareous, they will effervesce with acids; if silicious, they will scratch glass; if aluminous, they will be soft, easily scratched with a knife, and incapable of effervescing with acids.

4. Most soils, besides stones and gravel, contain larger and smaller proportions of sand of different degrees of fineness; and the next operation necessary is to separate this sand from the parts more minutely divided, such as clay, loam, marl, and vegetable and animal matter. This may be done sufficiently by mixing the soil well with water, as the coarse sand will generally fall to the bottom in the space of a minute, and the finer in two or three minutes; the sand will be, for the most part, separated from the other substances, which, with the water containing them, must be poured off into a filter. After the water has passed through,

what remains on the filter must be dried and weighed, as must also the sand, and their respective quantities must be noted down: the water must be preserved, as it will contain the saline matter, and the soluble animal or vegetable matter, if any existed in the soil.

5. A minute analysis of the sand thus separated, is seldom or never necessary; and its nature may be detected in the same way as that of stones and gravel. It is always silicious sand, or calcareous sand, or both together. If it consist wholly of carbonate of lime, it will dissolve rapidly in muriatic acid with effervescence; but if it consists partly of this and partly of silicious matter, a residuum will be left after the acid has ceased to act on it; the acid being added till the mixture has a sour taste, and has ceased to effervesce. This residuum is the silicious part, which being washed, dried, and heated strongly in a crucible, the difference of its weight from that of the whole, will indicate the quantity of calcareous sand.

6. The finely divided matter of the soil is usually very compound in its nature; it sometimes contains all the four primitive earths or soils, as well as animal and vegetable matter; and to ascertain the proportions of these with tolerable accuracy, is the most difficult part of the subject. The first process to be performed in this part of the analysis, is the exposure of the fine matter of the soil to the action of muriatic acid. This acid, diluted with double its bulk of water, should be poured upon the earthy matter in an evaporating basin, in a quantity equal to twice the weight of the earthy matter. The mixture should be often stirred, and suffered to remain for an hour or an hour and a half before it is examined. If any carbonate of lime or of magnesia exist in the soil, they will have been dissolved in this time by the acid, which sometimes takes up likewise a little oxide of iron, but very seldom any alumine. The fluid should be passed through a filter; the solid matter collected, washed with distilled rain water; dried at a moderate heat, and weighed. Its loss will denote the quantity of solid matter taken up. The washings must be added to the solution, which, if not sour to the taste, must be made so by the addition of fresh acid, and a little

solution of prussiate of potash must be mixed with the liquor. If a blue precipitate occurs, it will denote the presence of oxide of iron; and the solution of the prussiate must be dropped in till no further effect is produced: to ascertain its quantity, it must be collected on a filter, in the same manner as the other solid precipitates, and heated red: the result will be the oxide of iron. Into the fluid freed from the oxide of iron, a solution of carbonate of potash must be poured, till all effervescence ceases in it, and till its taste and smell indicate a considerable excess of alkaline salt: the precipitate that falls down is carbonate of lime, which must be collected on a filter, dried at a heat below that of redness, and afterwards weighed: the remaining fluid must be boiled for a quarter of an hour, when the magnesia, if there be any, will be precipitated, combined with carbonic acid, and its quantity must be ascertained in the same manner as that of carbonate of lime. If any minute proportion of alumine should, from peculiar circumstances, be dissolved by the acid, it will be found in the precipitate with the carbonate of lime, and it may be separated from it by boiling for a few minutes with soap ley, sufficient to cover the solid matter, for this ley dissolves alumine without acting upon carbonate of lime. Should the finely divided soil be sufficiently calcareous to effervesce very strongly with acids, a simple method of ascertaining the quantity of carbonate of lime, sufficiently accurate in all common cases, may be adopted. As carbonate of lime, in all its states, contains a determinate quantity of acid, which is about 45 parts in a hundred by weight, the quantity of this acid given out during the effervescence occasioned by its solution in a stronger acid, will indicate the quantity of carbonate of lime present: thus, if you weigh separately one part of the matter of the soil, and two parts of the acid diluted with water, and mix the acid slowly in small portions with the soil, till it ceases to occasion any effervescence, by weighing the mixture and the acid that remains, you will find the quantity of carbonic acid lost; and for every four grains and a half so lost, you will estimate ten grains of carbonate of lime.

7. The quantity of insoluble animal and vegetable matter may next be ascertained with sufficient precision, by heating it to a strong red heat, in a crucible, over a common fire, till no blackness remains in the mass, stirring it frequently meanwhile with a metallic wire: the loss of weight will ascertain the quantity of animal and vegetable matter there was, but not the proportions of each: if the smell emitted during the process resembles that of burnt feathers, it is a certain indication of the presence of some animal matter, and a copious blue flame almost always denotes the presence of a considerable proportion of vegetable matter. Nitrate of ammonia, in the proportion of twenty grains to a hundred of the residuum of the soil, will greatly accelerate this process, if the operator be not in haste, and not effect the result, as it will be decomposed and evaporate.

8. What remains after the decomposition of vegetable and animal matter, consists generally of minute particles of earthy matter, which are usually a mixture of alumine and silex, with oxide of iron. To separate these, boil them two or three hours in sulphuric acid, diluted with four times its weight of water, allowing an hundred and twenty grains of acid for every hundred grains of the residuum; if any thing remains undissolved by this acid, it may be considered as silex, and be separated, washed, dried, and weighed in the usual manner. Carbonate of ammonia being added to the solution in quantity more than sufficient to saturate the acid, the alumine will be precipitated, and the oxide of iron, if any, may be separated from the remaining liquid by boiling it. It scarcely ever happens that any magnesia or lime escapes solution in muriatic acid; but if it should, it will be found in the sulphuric acid, from which it may be separated as before directed for the muriatic acid. This method of analysis is sufficiently precise for all common purposes; but if very great accuracy be an object, the residuum, after the incineration, must be treated with potash, and in the manner in which stones are analysed, as given in the first part of this article.

9. If the soil contained any salts, or soluble vegetable, or animal matter, they will be found in the water used for separating the sand: this water must be evaporated to dryness, at a heat below boiling: if the solid matter left be of a brown color, and inflammable, it may be considered as partly vegetable extract; if its smell, when exposed to heat, be strong and fœtid, it contains animal, mucilaginous, or gelatinous matters; if it be white and transparent, it may be considered as principally saline. Nitrate of potash, or of lime, is indicated in this saline matter by its sparkling when thrown on burning coals; sulphat of magnesia may be detected by its bitter taste; and sulphat of potash produces no alteration in a solution of carbonate of ammonia, but precipitates a solution of muriate of barytes.

10. If sulphat or phosphat of lime be suspected in the soil, a particular process is requisite to detect it: a given weight of the entire soil, as four hundred grains for instance, must be mixed with one-third its weight of charcoal, and kept at a red heat in a crucible for half an hour. The mixture must then be boiled a quarter of an hour in half a pint of water, and the solution, being filtered, exposed some days to the open air. If any soluble quantity of sulphat of lime, or gypsum existed in the soil, a white precipitate will gradually form in the fluid, and the weight of it will indicate the proportion. Phosphat of lime, if any present, may be separated from the soil after the process for gypsum. Muriatic acid must be digested upon the soil in quantity more than sufficient to saturate the soluble earths; the solution must be evaporated, and water poured upon the solid matter; this fluid will dissolve the compounds of earths with the muriatic acid, and leave the phosphat of lime untouched.

11. When the examination of a soil is completed, the products should be classed, and their quantities added together, and if they nearly equal the original quantity of soil, the analysis may be considered as accurate. It must, however, be observed, that when phosphat or sulphat of lime is discovered by the independent process, No. 10, just mentioned, a correction must be made for the general process, by subtracting a sum equal to

their weight from the quantity of carbonate of lime obtained by precipitation from the muriatic acid, in arranging the products, the form of the experiments by which they are obtained—thus, 400 grains of a good silicious sandy soil may be supposed to contain,

	Grains.
Of water absorption, - - - - - -	18
Of loose stones and gravel, principally silicious, -	42
Of undecompounded vegetable fibres, - -	10
Of fine silicious sand, - - - - - -	200
Of minutely divided matter, separated by filtration, and consisting of carbonate of lime,	25
Carbonate of magnesia, - - - - -	4
Matter destructible by heat, chiefly vegetable, -	10
Silex, - - - - - - - -	40
Alumine, - - - - - - -	32
Oxide of iron, - - - - - - -	4
Of soluble matter, principally sulphat of potash and vegetable extract, - - - -	5
Gypsum, - - - - - - - -	3
Phosphat of lime, - - - - - -	2
Amount of all the products, - - -	395
Loss, - - - - - - - -	5
Total, - - - - - - - -	400

In this instance the loss is supposed small, but in general, in actual experiments, it will be found much greater, in consequence of the difficulty of collecting the whole quantities of the different precipitates; and when it is within thirty for four hundred grains, there is no reason to suspect any want of due precision in the process.

12. When the experimentalist has become acquainted with the use of the different instruments, the properties of the agents, and the relations between the external and chymical qualities of soils, he will seldom find it necessary to perform, in any one case, all the processes that have been described. When the soil, for instance, contains no notable proportion of calcareous matter, the action of the muriatic acid, No. 6, may be omitted in examining peat soils; he will principally have to attend

to the operation by fire and air, No. 7, and in the analysis of chalks and loams he will be often able to omit the experiment with sulphuric acid, No. 8.

In the first trials made by persons unacquainted with chymistry. they must not expect much precision, for many difficulties will be met with, but in overcoming them the most useful kind of practical knowledge will be obtained, and nothing is so instructive in experimental science as the detection of mistakes. The correct analyst ought to be well grounded in general chymical information, but perhaps there is no better mode of gaining it than in attempting original investigations. In pursuing his experiments he will be continually obliged to learn from books the history of the substances he is employing or acting upon, and his theoretical knowledge, by being combined with practice, will therefore be more valuable.

On the uses to which each Soil may be most advantageously applied.

Clay soils, when sufficiently enriched with manures, are naturally well qualified for carrying crops of wheat, oats, beans and clover; but are not fit for barley, turnips, potatoes, &c. or even for being kept under grass longer than one year. Perhaps such soils ought to be regularly summer fallowed, once in six, or at least in eight years, even when they are comparatively in a clean state; as they contract a sourness, and adhesion from wet ploughing, only to be removed by exposure to the sun and wind, during the dry months of summer. Soils of this kind receive little benefit from winter ploughing, unless so far as their surface is thereby presented to the frost, which mellows and reduces them in a manner infinitely superior to what could be accomplished by all the operations of man; still they are not cleaned or made free of weeds by winter ploughing, and, therefore, this operation can only be considered as a good mean for procuring a seed-bed, in which the seeds of the future crop may be safely deposited: hence the necessity of cleaning clay soils during the summer months, and of having always a large part of every clay farm under

summer fallow. All clay soils require great industry and care, as well as a considerable portion of knowledge in the dressing or management, to keep them in good condition; yet, when their natural toughness is got the better of, they always yield the heaviest and most abundant crops. One thing requisite for a clay soil, is to keep it rich and full of manure; a poor clay being the most ungrateful of all soils, and hardly capable of paying the expense and labor, after being worn out and exhausted. A clay soil also receives, comparatively, small benefit from grass, and when once allowed to get into a sterile condition, the most active endeavors, will with difficulty restore fertility to it, after the lapse of many years.

Upon light soils, the case is very different: these flourish under the grass husbandry, and bare summer fallow is rarely required, because they may be cleaned and cropped in the same year with that valuable esculent, turnip.

Upon light soils, however, wheat can seldom be extensively cultivated, nor can a crop be obtained of equal value, either in respect of quantity or quality; as on clays and loams. The best method of procuring wheats on light lands, is to sow upon a clover stubble, when the soil has got an artificial solidity of body; and is thereby rendered capable of sustaining this grain, till it arrives at maturity. The same rule applies to soils of a gravelly nature, and upon both, barley is found to be of as great benefit as wheat The facility with which every variety of light soil is cultivated, furnishes great encouragement to keep them under the plough, though it rarely happens, that when more than one half of such soils are kept in ploughing, the possessors are greatly benefitted. Thin clays, and peat earths, are more friendly to the growth of oats than other grains, though in favorable seasons a heavy crop of wheat may be obtained from a thin clay soil, when it has been completely summer fallowed, and enriched with manure. A first application of calcareous manure is generally accompanied with great advantage upon these soils, but when once the effect of this application is over, it can hardly be repeated a second time, unless the land has been very cautiously managed

after the first dressing. Neither of these soils are friendly to grass, yet there is a necessity of exercising this husbandry with them; because they are incapable of standing the plough more than a year or two in rotation. It is sufficient to say, that wheat should be the predominant crop, on all the rich clays and strong loams; and that light soils of every kind, are well qualified for turnips, barley, &c. upon the thin and moorish soils, oats must necessarily predominate, or preserve a prominent rank; and grass seeds may be cultivated upon every one of them, though with different degrees of advantage, according to the natural and artificial richness of each soil, or to the qualities which it possesses for encouraging the growth of clover, in the first instance, and preserving the roots of the plant afterwards.

On Tillage.

Tillage, may in general, be described as an operation whereby the soil is either cleared from noxious weeds, or prepared for receiving the seeds of plants, cultivated by the husbandman. When this operation is neglected, or even partially executed, the soil becomes foul, barren and unproductive; hence, upon arable farms, tillage forms the prominent branch of work; and according to the perfection or imperfection with which it is executed, the crops of the husbandman, whether of corn or grass, are in a great measure regulated.

Tillage, in the early ages, was performed by hand labor; but in modern times, the plough has been the universal instrument for executing this necessary and important branch of rural work. In no other way can large fields be turned over, because the expense of digging with the spade, the only other method of turning over the ground, would much exceed the profit that could be reaped. Spade work, however, is almost universally used in garden culture, where the plants raised are of greater value than those cultivated in the fields; though the nearer that field culture can be brought to what is exercised in a garden, so much more may the practice of the art be considered as approximating in perfection to that of the other.

On the utility of Summer Fallow.

The necessity of summer fallow depends greatly upon the nature and quality of the soil; as, upon some soils, a repetition of this practice is less frequently required than upon others.

Wherever the soil is incumbent upon clay, it is more disposed to get foul, than when incumbent upon a dry, gravelly bottom; besides, wet soils, from being ploughed in winter, contract a stiffness which lessens the pasture of artificial plants, and prevents them from receiving sufficient nourishment. When land of a dry, gravelly quality gets foul, it may easily be cleaned without a plain summer fallow; since crops, such as turnips, &c. may be substituted in its place, which, when drilled at proper intervals, admit of being ploughed as often as necessary; whereas wet soils, which are naturally unfit for carrying such crops, must, by frequent ploughings and harrowings, be brought into good order during the summer months.

A well managed fallow should be wrought as early in the season as possible, and continually turned over so long as the least particle of quickens, or weeds, appears. It is no argument against the utility of fallows, that they are often managed in a different way: this militates only against the impropriety of the management, but not against the practice itself.

The necessity of summer fallow turns upon this single point: Can wet lands be advantageously employed in raising turnips or cabbages? a question which the practical farmer, who is sufficiently acquainted with the nature of such soils, and the immense labor required to bring them into proper tilth, will have no difficulty to answer in the negative. It is not disputed that turnips and cabbages will grow upon these soils; but the question is, whether the extraordinary labor they require and the damage sustained by the ground, during the consumption, or carrying off the crops, will not exceed the value of the produce.

Upon all clay soils, (and upon such only it is understood that a complete summer fallow would be necessa-

-ay,) the first ploughing ought to be given during the winter months, or as early in the spring as possible, which promotes the rotting of the sward and stubble: this should be done by gathering up the ridge, which both lays the ground dry, and rips up the furrows. As soon as seed time is over, the ridge should be cloven down, preparatory to cross ploughing; and after lying a proper time, should be harrowed and rolled repeatedly; and every particle of quickens that the harrows have brought above, should be carefully picked off with the hand. It is then proper to ridge or gather it up immediately, which both lays the land in proper condition for meeting bad weather, and opens up any fast land that may have been missed in the furrows, when the cross ploughing is given. After this, harrow, roll, and gather the root-weeds again, and continue so to do till the field is perfectly clean.

Considering how much weeds prevail in fields, and how difficult it is, even for the most attentive farmers, to prevent their crops being hurt by them, frequent fallowing, as the most proper method of destroying these enemies, cannot be too much recommended: when we have arrived at greater perfection in the several operations of agriculture, and brought our lands to a higher degree of fertility than at present, then should we think of introducing schemes of perpetual cropping.

A mode of executing summer fallow and producing a crop of turnips, in the same year, comes now to be noticed. In this way the land may be completely cleaned; perhaps more so than by a bare fallow; it is only on light, dry soils, that such a mode of cleaning is engible, or can be executed with advantage.

The second object of tillage is to prepare the ground for receiving the seeds of plants cultivated by the husbandman; and here, in general, it may be remarked that the object is most completely accomplished when the ground is ploughed deep and equal, while the bottom of the furrow immediately above the subsoil, is perfectly loosened, and turned equally over with the part that constitutes the surface. In many places these properties are altogether neglected, the ground being ploughed in a shallow way, while the bottom of the

ploughed land remains something like the teeth of a saw, having the under part of the furrow untouched, and consequently not removed by the action of the plough: while these things are suffered, the object of tillage is only partially gained: the food of plants, *(whatever it may be,)* can only be imperfectly procured, and the ground is drenched and injured by wetness; these bridges or pieces of land, which are not cut, preventing a descent of the moisture from above to the open furrows left for carrying it off Where the seed bed is prepared by one ploughing, the greatest care ought to be used in having it closely and equally performed.

When two are given, they should be in opposite directions; so that any firm land left in the first, may be cut up in the second ploughing: it is not profitable to plough twice one way, if it can be safely avoided.

Another important point towards procuring good tillage, is never to plough the land when in a wet state, because encouragement is thus given to the growth of weeds, while a sourness and adhesion is communicated to the ground, which is rarely got the better of till the operations of a summer fallow are again repeated.

Before I finish the directions for ploughing, it is proper to remark, that all soils ought not to be wrought or ploughed in one manner: each kind has its particular and appropriate mode of tillage. Ploughing, which is the capital operation of husbandry, ought, on these accounts, to be administered according to the nature of the soil which is to be operated upon, and not executed according to one fixed and determinate principle. On strong clays and loams, and on rich gravel and deep sands, the plough ought to go as deep as the cattle are able to work it; whereas, on thin clays and barren sands, the benefit of deep ploughing is very questionable, especially when such are incumbent on a till bottom, or where the subsoil is of a yellow ochre nature: such, when turned up, being little better than poison to the surface, unless highly impregnated with alluvial compost, the effect of which expels the poisonous substances contained in this kind of subsoil, and gives a fertility to the whole mass, more decisive and permanent than would follow a heavy application of the best rotten dung.

On clay soils, where the ridges must be considerably acclivated, so that the ground may be preserved in something like a dry condition, the plough, used for tillage, ought to have a mouldboard considerably wider set than is required for light soils, in order that the furrows may be close cut below, and duly turned over. This method of constructing the plough necessarily makes a heavier draft than would be the case were the mould-board placed differently; though, if good and sufficient work be wanted, the necessity of constructing the implement in the way mentioned, is absolute and indispensible. The plough to be used on light soils, or on all soils that admit what is technically called Crown ploughing, may be made much narrower below, and yet be capable of executing the work in a perfect manner. Perhaps on every farm, consisting of mixed soils, two sets of ploughs ought to be kept; otherwise proper work cannot be performed. All land ought to be ploughed with a shoulder, a phrase well understood by ploughmen, though not easily explained; and the advantages of ploughing this way are, that if ploughed before winter, the surface is able to resist the winter rains, and afterwards to present a face on which the harrows can make a proper impression when the seed process is to be executed: This deserves particular attention when old grass fields are to be broken up, as, by neglecting it, the harrows often are unable to cover the seed. It is perfectly practicable to plough land with a tolerably broad furrow, say 10, 11, or 12 inches, and yet to plough it clean, provided the implement used is properly constructed; but then care must be taken that the furrow be of proportional deepness; otherwise it will be laid on its back, instead of being deposited in an angle proper for undergoing the harrowing process.

On Manures.

The term manure is applied indiscriminately to all substances, which are known, from experience, either to enrich the different soils or contribute, in any other way, to render them more favorable to vegetation.

Though little doubt can be entertained of the utility and necessity of such substances, yet the progress hitherto made, in ascertaining the mode in which they ought to be applied; the quantity that should be made use of; and the soils for which they are best adapted, has not reached that perfection or certainty that could be wished.

The most superficial observations will serve to convince any person, that, in an agricultural point of view, the subject of manures is of the first magnitude. To correct what is hurtful to vegetation in the different soils, and to restore what is lost by exhausting crops, are operations in agriculture which may be compared to the curing of diseases in the animal body, or supplying the waste occasioned by labor, or the ordinary evacuations of nature.

It can be easily noticed that a considerable number of practical agriculturists are inattentive, not only to the gathering of raw materials, but also defective in the several steps of preparatory process, before dung or manure can be thriftily and suitably applied: With such, very little care is used in cutting the corn crops, which, properly speaking, is the only source whence raw materials can be got. They are also too apt to dispose of any hay which may be raised upon their farms, even when prices are not so high as to tempt a breach of good husbandry. They often keep more beasts on the premises than is consistent with the quantity of provender on hand, thus reducing the stock of manure in an extraordinary degree. Besides, seldom is any care bestowed in laying up the dung in a regular and careful way, during the winter months, and still less upon its state, during the exhausting spring winds, or the parching heat of summer months Instead of storing up with regularity, and mixing the different kinds in a compact heap, it is suffered to remain as tossed from the stable, continues exposed in its rough state to the weather, often inundated with water, and rarely touched till the cart arrives to draw it out to the field. The middle of April is mentioned as a good time for clearing the fold yard; but this does not prevent the work from going partially forward through the

winter, when suitable opportunities occur; when driven out of the fold yard, the dung should be laid up in a regular heap or pile, not exceeding four feet and a half in height, and care should be taken not to put either horse or cart upon it, which is easily avoided, backing the cart up to the pile and laying the dung compactly together with a fork; it is also useful to face up the extremities with earth, which keeps in the moisture and prevents the sun and wind from doing injury. Perhaps a small quantity of earth strewed upon the top, may also prove useful Dung when managed in this manner, generally ferments very rapidly; but if it is discovered to be in a backward state, a complete turn over, about the first of May, when the weather becomes warm, will quicken the process, and the better it is shaken asunder the sooner will the object in view be accomplished.

A secluded spot of ground, not much exposed to wind, and perfectly secure from being floated with water, ought always to be chosen for the scite of such piles or heaps. If the field to which it is to be applied, is at hand, a little after trouble may be saved by depositing it there in the first instance; but it is found most convenient to reserve a piece of ground, convenient to the homestead, for this purpose—there it is always under the farmer's eye, and a greater quantity can be moved in a shorter time than when the situation is more distant; besides, in wet weather (and this is generally the time chosen for such an operation) the roads are not only cut up, by driving to a distance, but the field on which the heap is made, may be poached and injured considerably. The foregoing is the most approved method of preparing dung upon light land farms, and a few words shall now be said respecting the management necessary upon those of a different description.

Upon clay soils, the rotting of manure is not only a troublesome, but an extensive affair. Independent of what is consumed by the ordinary farm stock, the overplus of the straw must some how or other be rotted by lean cattle kept in the fold yard, who either receive the straw in racks, or have it thrown across the yard, to be eaten and trodden down by them. Accord-

ing to this method of consumption, it is evident that a still greater necessity arises for a frequent removal of this unmade manure, otherwise, from the trampling of beasts, and the usual want of moisture, it would compress so much as altogether to prevent putrefaction. To prepare dung sufficiently upon farms of this description, is at all times an arduous task, but scarcely practicable in dry seasons; for if it once gets burnt, it is almost physically impossible to bring it into a suitable state of preparation afterwards; and, at all events, its virtues are thereby considerably diminished. To prevent such an injury, no measure can be so successfully used as frequent removal of this unmade manure, especially if the weather is wet at the time. If people can stand out to work, there cannot be too great wetness when executing this operation; for there is always such a quantity of the straw that has not passed through the entrails of the cattle, as renders it almost impossible to do injury in the first instance by an excess of moisture.

It is therefore recommended, upon every clay land farm, especially those of considerable size, that the fold yard be frequently cleaned, and that the greatest care be taken to mix the stable or horse dung in a regular way with what is gathered in the fold yard, or made by other animals, in order that a gradual heat or fermentation may be produced.

The heap, or pile as already recommended, in the first preparation of dung, should be formed in a secluded spot, if such can be got at hand, because the less it is exposed to the sun or wind, so much faster will fermentation proceed. It should be constructed on a broad basis, which lessens the bounds of the extremities, and several separate heaps are necessary, so that too much may not be deposited at once; which, to a certain extent, would bring on the very evil I have all along been endeavoring to avert. By shifting the scene frequently, and allowing each covering or coat to settle and ferment before laying on any more, the most happy effects will follow; and these heaps *(at least all such as are completed before the first of May)* may reasonably be expected to be in a fit condition for applying to the summer fallow fields, in the end of July or the first

of August. If the external parts get dry at any time during the process, it will be proper to water them thoroughly, and in many cases to turn over the heap completely. It may be added, that much benefit has been experienced from laying a thick coating of snow upon such heaps, as, by the gradual melting thereof, the whole moisture is absorbed, and a strong fermentation immediately follows. The same method of management may be continued during the summer months, so far as circumstances permit; though it rarely happens that dung collected during summer, unless it be such as is made by keeping horses and cattle in the house upon green food. Perhaps, as a general principle, it is proper to thresh out all the grain before summer arrives, (*a small quantity of litter and other necessary purposes excepted,*) in order that the full value of the raw materials, when converted into manure, may be gained. Upon large farms, where the management of manure is sufficiently understood and practised, it is an important matter to have dunghills of all ages, and ready for use whenever the situation of a field calls for a restorative. No application to clay soils, however, is so useful as during the year of summer fallow, though in such situations a greater stock of manure is gathered than is required for the fields under this process.

It likewise deserves attention, that dung applied to a clay fallow at the end of a summer, has full time to incorporate with the ground before the crop sown thereupon stands much in want of its invigorating support; consequently, though of apparently inferior quality at the time of application, may, in reality, be possessed of equal powers for fructifying the ground, as if it had reached a higher state of preparation.

There never ought to be more dung or manure given at one time than is sufficient to fructify the ground, in other words, to render it capable of producing good crops, before the time arrives when a fresh dose can be administered. The errors of former times consisted in giving too great a quantity at once, thereby depriving the ground of its regular nourishment, or, in other words, the soil rioted in the midst of plenty, for two or three years, and fasted and starved for several succeed-

ing ones. Hence the generality of fields were either too rich or too poor; either saturated with manure, or completely barren for the want of it; whereas, had supplies been furnished in an economical manner; had the quantity of manure on hand been distributed with judgment, a more uniform produce would have been the consequence. The new system of applying manure, corrects all these errors, in so far as local circumstances will permit. Accordingly, a small quantity is now bestowed at once, and the dose frequently repeated—the ground is regularly fed, but never surfeited with a profusion. Hence the crops constituting a regular rotation, are uniformly good, and a greater proportion of the valuable grains are raised than could be accomplished in former times. Though land can rarely be rendered too rich for carrying green crops, yet it is well known that the same observation will not hold good when applied to wheat, barley and oats; but that such may be, and often has been materially injured in consequence of heavy manuring. Another general remark occurs—that is, concerning the utility of spreading dung with accuracy, or dividing it into the minutest particles, thereby giving every part of the ground an equal supply of food. This practice was miserably neglected in former times, and is still less attended to than its importance deserves.

On manuring Clay Lands with Sand, and Sandy Land with Clay, Marl, &c.

In the first place, different earths will serve to manure each other: thus, clay is a fertilizer of a light sandy soil, and sand is equally a fertilizer of clay. Where clay lands are in grass, the sand should be laid on as a top dressing, but where they are ploughed it should be well mixed with the soil for the purpose of destroying its adhesion. Sand which has been washed down in roads and elsewhere is best. Where clay is applied to a sandy soil, it should be carted on in the fall, and spread evenly on the ground, that the frost may pulverize it before it is mixed with the soil in the spring.

The better these earths are mixed in the respective soils, the more sensible and immediate will be their effects; but their principal excellence is, that they are calculated permanently to improve the soils to which they are applied. Stiff loams are also assisted by sand, and sand again by these, but neither in so great a degree as in the former case. Generally, it may be observed, that all light, dry soils, are improved by being mixed with heavy earths, and *vice versa*

Sand and fine gravel will greatly fertilize the soil of bog meadows, and this earth again is a very good manure for upland soils; it is peculiarly excellent for Indian corn, when applied to the hills, and is very good for flax, hemp, and most other summer crop; like gypsum, it is friendly to the growth of white clover. When applied to upland grasses, it should be laid on as a top dressing. Every kind of black mud, from ponds and swamps, answers a somewhat similar purpose; though, if the mud be stiff and clayey, it should only be applied to a light, dry soil.

The different sorts of marl, found in bog swamps, are also excellent manures for all upland soils. These earths are usually found at the depth of from one to three feet from the surface, and are either of a white, grey, or brownish colour; the former is the most efficacious, and the latter the least so, their strength being in proportion to the quantity of carbonate of lime they contain. It is best to mix these earths with the mass of black earth, or bog dirt, that forms the upper stratum, in order to reduce their strength, and, when thus mixed, a load of even the weakest kind is more efficacious than two of barn dung. Their operation as manures is similar to that of Nova Scotia plaster, or gypsum; having little or no effect when first applied to wheat and rye, but, by its afterwards covering the ground with a thick growth of white clover, it is rendered fit for producing largely of these crops. The same may be observed of bog dirt: like this, too, these marls are peculiarly excellent for Indian corn, and all summer grains, and a less quantity is sufficient. They may be used as top dressings or otherwise.

Of Compost.

The use of manure in the shape of compost, or ingredients of various qualities, mixed together in certain proportions, has long been a favorite practice with many farmers, though it is only in particular situations that the practice can be extensively or profitably executed. The ingredients used in these composts are chiefly earth and lime, sometimes dung where the earth is poor, but lime may be regarded as the main agent of the process, acting as a stimulus for bringing the powers of the heap into action. Lime, in this view, may be considered as a kind of yeast, operating upon a heap of earth as yeast does upon flour or meal. It is obvious, therefore, that unless a sufficient quantity is given, the heap may remain unfermented, in which case little benefit will be derived from it as a manure.

The best kind of earth for compost is that of the alluvial sort, which is always of a rich, greasy substance, often mixed with marl, and in every respect well calculated to enrich and invigorate barren soils, especially if they are of a light and open texture. Old yards, deep head lands, and scourings of ditches, offer themselves also as the basis of compost; but it is proper to summer fallow them before hand, so that they may be entirely free of weeds. When the lime is mixed with the soil of these heaps of clay, repeated turnings are necessary, that the whole may be suitably fermented, and some care is required to apply the fermented mass at a proper time to the field on which it is to be used.

Ashes, as a manure, are found to be more efficacious in some parts of the country than others, generally most so when applied to lands near the ocean. Wood-ashes generally answers the most valuable purpose, when applied to Indian corn, particularly where the soil is not suitable to this plant Where the soil is wet, cold, loamy, or clayey, the plants are apt to get stunted by the cold rains which usually fall after planting, and then the ashes serve to supply the natural deficiencies of the soil, till it becomes fertilized by the summer sun; but, where the soil is natural to the growth of the plant, and there is no danger of its being stunted at its outset,

perhaps it may be better to apply the ashes later, so that the plants may derive the greatest assistance from this manure, while the ears are setting and forming. Ashes should generally be used for a top dressing, as their salts lose nothing by exposure to the air, and soon find their way into the soil.

Coal ashes are a good manure. They are sown on the land in the spring, at the rate of four or five chaldrons per acre. Cold, wet clay meadows are much improved by them. Soot is much more efficacious than ashes—besides salts, it contains oil. The soot of coal is esteemed equally as good as that of wood; it is used for top dressings, and requires from forty to fifty bushels to the acre. When applied to winter grain, it should be sown in the spring; and the same may be observed of ashes. Soot is excellent for sanfoin, clover, lucerne, and for meadows which have become sour and mossy. This manure can, however, only be had in considerable quantities in large towns. Of salts, which serve as manures, the principal are the common sea salt, urine, stale of cattle, sea water, saltpetre, and alkaline salts—to the latter the virtue of ashes, as a manure, is principally owing. Soap suds is in part valuable on account of its alkaline salts, and perhaps the neutralized oil it contains adds much to its value. It is usual to throw this oil away, but this is a needless waste—it may be taken in the watering pot, and strewed over the garden, where it will be of great service as a manure, and in expelling insects. Common salt is considered more efficacious when mixed in composts, than when applied in its crude state to the soil. If cattle are not regularly salted the barn dung will scarce be worth moving; and were it not the fear of rendering this section too prolix, I could mention several profitable agricultural experiments by means of salt. Sea water is said to contain saltpetre, sulphur, and oil, besides common salt, and is therefore preferable to common salt as a manure, when put in composts or otherwise; but it is where the local situation of the farmer will enable him to procure it without much expense, that it can be used to advantage.

Sea weed is a plant that grows upon rocks within the sea, is driven ashore after storms, and is found to be an

excellent article for manuring light and dry soils, though of little advantage to those of a clayey description. This article may be applied on the proper soil with advantage to any crop, and its effects are immediate, though rarely of long continuance. Sea weed is applied at all seasons to the surface, and sometimes, though not so profitably, it is mixed with unrotten dung, that the process of putrefaction may be hastened Generally speaking, it is at once applied to the soil, which saves labor and prevents that degree of waste which otherwise would necessarily happen. Sea weed is, in one respect, preferable to the richest dung, because it does not produce such a quantity of weeds. Some have thought that the weeds upon land which have received dung, are produced by seeds mixed with the dung; but it is reasonable to presume that the salts contained in sea weed, and applied to it, may be the real cause of the after cleanliness. This may be inferred from the general state of coast-side lands, where sea weed is used: these lands are almost constantly kept in tillage, and yet are cleaner and freer from weeds than those in inland situations, where the corn crops are not so often taken.

Lime will reduce peat and turf to a mere vegetable earth, but it never proceeds so far in the work of decomposition as to destroy vegetable matter or lessen its quantity where it abounds. Lime is of singular use in destroying the adhesive quality of stiff clays, and it is on soils of this description, and on cold loams, that it has been considered in Great Britain as most efficacious. On such soils it is usual to apply about two hundred and forty bushels to an acre, which is considered a full manuring, the effects of which are usually manifest for eight, ten, and twelve of the succeeding crops. If lime be applied to the lighter and drier lands, not much more than half of that allowance is given at once. Lime operates equally well, whether applied when fresh slacked, or when it has been some time slacked, provided the condition of the ground be such as to render a calcareous application beneficial. It is not material whether lime be used on grass land, or summer fallow, but may be applied as may be most convenient, especially on new clean grass land. On land which has

long lain in grass, it is thought best to take one crop after breaking it up, and then to summer fallow and apply the lime.

The liming of moorish lands is hazardous, unless dung be likewise bestowed; and to repeat the operation of liming, especially where such soils have been severely cropped, is almost certain loss; and in such cases, a compost of lime and rich earth is the only substitute.

The strong clays and loams require a full dose of lime to bring them into action, as such soils are capable of absorbing a great quantity of calcareous matter, and, of course, the lighter soils require less lime to stimulate them, and may be injured by a quantity that would prove but moderately beneficial to heavy soils.

I have also to notice, that upon fresh land, or that which is in a proper state for an addition of calcareous earth, lime is much superior to dung, as its effects continue for a longer time; while the crops thus grown are of a superior kind, and are less liable to be injured by drought, or by excess of moisture, and the stiff soils particularly are much easier worked when well limed: this circumstance alone ought therefore to be a sufficient inducement to apply lime to such grounds, if it possesses no fertilizing property. Finally, though strong soils require to be animated with a good dose of lime, yet those of a lighter texture require but little more than half the allowance of the former, especially where they are fresh, or have not been before limed; still judgment is required in the application. But that it is generally safer to exceed the proper quantity than to be below it; for that, in this latter case, the manure may prove wholly useless, while it rarely happens that the ground is injured by an excess of lime, especially if more or less dung be soon after administered. Lime is also of singular use in producing a high degree of fermentation, in all soils which require it, and this is essential to their productiveness in every country and climate.

Chalk is used to great advantage on some wet, stiff soils, having no calcareous earth; in quantity, from fifty to eighty loads per acre. Its beneficial effects are

said to last twenty years. The best method of using is to spread it early in the autumn, in order that it may be thoroughly drenched with rain, and that the frost may have its full operation upon it, by which means it is well pulverized when the thaw comes on, and will mix the more readily with the soil. Old grass land, or wet sandy or clayey soils, overrun with furze or rushes, are greatly improved by chalk; but it is to be observed, that land once completely chalked, after its fertilizing powers appear to be exhausted, is reckoned to be inferior to land that never was chalked.

Gypsum, or Plaster of Paris, is a native combination of calcareous earth with vitriolic acid. There are various species of gypsum found both in Europe and America. That mostly used in the United States, comes from the Bay of Fundy, though considerable quantities are procured from the interior of the states of Pennsylvania and New York.

The uses of gypsum are very extensive: when it is sufficiently compact, it is employed by the architect for columns and other ornaments, being easier to work than marble; it is also turned by the lathe into cups, basons, and other similar articles. When exposed to a low red heat it parts with its water of crystalization; is converted to a fine powder, called Plaster of Paris, like meal, and this, when beaten up with water to the consistence of paste, shortly after sets and becomes solid; hence it is largely used for taking casts of various magnitude, from a medal to a Colossal statue. It enters into the composition of many cements, and within these few years has also become an article of great importance in fertilizing soils. It is difficult to determine what quantity per acre will produce the best effects, as so much will depend on the weather; but in general as great effects have been produced by two bushels per acre as from any larger quantity. Indeed, there seems to be a certain point in the operations of plaster which is not gained by additional quantity so much as by a combination of extraneous circumstances, difficult to trace or account for; for almost all soils, except clay lands and wet loams, this is the cheapest manure that can be applied; and its use in

this country serves greatly to equalize the value of lands, by rendering those which are naturally poor almost as productive as the rich. The gypsum that abounds in the interior of the state of New York, is much superior to that of Nova Scotia, not only as to its being a greater stimulant to the growth of plants, but in regard to its being more general in its operation—better calculated to assist the growth of all plants in all soils and situations. It has been successfully applied to old meadow land of timothy grass, to growing crops of wheat, and in all cases where the Nova Scotia plaster is applied with little or no effect. In other instances, however, can be seen its inoperative qualities on timothy grass, on dry loam, while it has its usual effect on clover growing on the same soil. Its effects are not always the same, but most certain when applied to clover, by greatly increasing that crop, and by putting the land in good condition for almost any other, when the clover sward is turned under. As gypsum, when sown on suitable ground, always produces a spontaneous growth of white clover, and as this growth is an indication of the soil being thus rendered in good condition for a crop of wheat or rye, where, therefore, either of these crops are to be raised on fallow lands, the better way is to sow the gypsum early in the spring, and, as soon as the growth of this clover is produced, break up the soil, and prepare it for the crop by further ploughing in due season, and in this way the product will be double what might be expected on the same ground without the application of this manure. The most powerful operation of this manure, in proportion to the quantity used, is in applying it to dry seeds, after being soaked in some fertilizing liquor, such as a mixture of old urine, ley of wood ashes, or strong soap suds, with a solution of salt petre, and sown or planted immediately.

The effects of such treatment on seeds of Indian corn, buckwheat, peas, oats, barley, and perhaps flax, will probably be found the greatest, but, if the gypsum of the state of New York be used, its effects may be found more generally useful. When potatoes are cut for planting, it is of singular use to the growth of the crop to sprinkle on gypsum before the cut parts have dried,

and also to apply some to the hills before the seed is covered, about a table spoonful to each.

Indian corn is also greatly benefitted by a similar application to the hills: let the gypsum be scattered a little in both cases. Plaster is sufficiently fine when ground to produce 20 bushels to the ton; if it is finer, it is subject to fly away in strewing. It should always be remembered that calcination, however necessary it may be to make cement of plaster, lessons, if not destroys its agricultural uses. To try the quality of plaster, heat a small quantity of it pulverized in a pot over a brisk fire; if the effervescence of a sulphureous smell be considerable, it is good; if it be small, it is less valuable; and if it remains inert, like sand, it is worth nothing. When soils are suitable, gypsum is applied with great advantage to every species of vegetation.

Could bone dust be procured in sufficient quantity, and at a reasonable price, few substances would be more advantageous as a manure. Its effects upon the soil, though not immediately apparent, are in the highest degree beneficial; and their durability does not constitute the least portion of their value. Bone dust is applied in agriculture in the same manner as plaster of Paris.

On the cultivation of Culmiferous Crops.

The varieties of grain, ranked as culmiferous, are, wheat, barley, oats and rye. These varieties we are to consider as bearing hard upon the soil, and it does not matter much which of them are taken, because all are robbers of the ground, and tend to exhaust it of its productive powers. No doubt some soils are more favorable for one sort of grain than another, as, for instance, clays and loams are better adapted for wheat than sands and gravels; while sandy or gravelly land is better calculated for barley and oats than the other. It is by fixing upon the most proper of each for the soil cultivated, that the judgment of the farmer is correctly ascertained.

As wheat is the most valuable grain cultivated in this country, I shall treat of the several processes connected with its culture in a more particular manner than may be required when treating of other grains.

I shall first speak of the soils best adapted to the growth of wheat; 2d. of the culture required for that grain; 3d. of the varieties of seed; 4th. of the way it is sown; 5th. of pickling wheat so that it may be preserved from being smutted or blacked; and 6th. of the diseases to which wheat is liable in its different stages.

On the Soils best adapted to the growth of Wheat.

Rich clays and heavy loams are naturally well calculated for producing wheat; but any kind of clay and loamy soil, situated in a proper climate, may be artificially adapted to the growth of that grain by enriching it with a sufficient quantity of manure. On soils of the first description, wheat may be cultivated almost every second year, provided due care is taken to keep the land clean and in good condition. A summer fallow once in four, six, or eight years, according to seasons and circumstances, is, however, necessary; and manure should be applied on that fallow for the first crop of wheat. Light soils, though they will, with the exception of soft sands, produce wheat of excellent quality, are not constitutionally disposed to the growth of that grain. Summer fallow on them may safely be dispensed with, because a crop of turnips, which admits every branch of the cleaning process to be more perfectly executed than even a naked or bare fallow does, may be profitably substituted. Wheat here comes in with propriety, after turnips, though, in general cases, it must be sown in the spring months, unless the turnips are stored, in which case it may be sown in November, or it may be sown after clover for the fourth crop of the rotation, or in the sixth year, as a way-going crop, after drilled peas and beans, if the rotation is extended to that length. Neither is it possible to raise wheat so extensively upon light soils, even where they are of the richest quality; as is practicable upon clays; nor will a crop of equal bulk, upon the one, return so much produce in grain as may be got from the other.

On the culture required for Wheat.

On soils really calculated for wheat, though in different degrees, summer fallow is the first and leading step to gain a good crop, or crops of that grain. The first furrow should be given before winter, or as early as other operations upon the farm will admit, and every attention should be used to go as deep as possible, for it rarely happens that any of the succeeding furrows exceed the first one, in that respect, the number of after ploughings must be regulated by the condition of the ground and the state of the weather; but in general it may be observed, that ploughing in length and across, alternately, is the way by which the ground will be most completely cut, and the intention of fallowing accomplished. In a dry season it is almost impracticable to reduce real clays or to work them too small, and even in a wet one, supposing they are made surface smooth, they will, when ploughed up again, consolidate into clods or lumps, after forty-eight hours drought, and become nearly as obdurate as ever. It is only on thin soils, that have a mixture of peat earth, and are incumbent on a bottom impervious to water, that damage is at any time sustained from over harrowing.

Another method of preparing land for Wheat.

In the winter season carry on a sufficient quantity of manure, and as soon as the frost is out of the ground plough it over smooth, furrow it and plant it with potatoes, in hills, leaving just room enough between the hills to plough both ways. When they are grown to the height of two or three inches, plough them one way, turning the furrow upon the hills on each side, having a person to follow and weed them out.

About the end of June cross plough them, turning upon the hill again, and let the person following the plough mould the hills; and about the twentieth of August you will find that the tops will die; then pull them, for the longer they remain in the earth the more water they will collect in their substance.

As soon as the potatoes are gathered turn in your hogs, and let them remain there till the beginning of October; they will by this time have torn up and mixed the ground better than any ploughing; then harrow the ground for sowing wheat. The advantages are, that the potatoes kill the weeds and turf; and the hogs, by rooting and turning the soil in search of potatoes, effectually destroy all kinds of vermin that have been left in the ground, besides a considerable saving in their keeping.

Wheat—*Varieties of Seed.*

Wheat may be classed under two principal divisions; though each of these admits of several subdivisions: The first is composed of all the varieties of red wheat, but as such are now rarely sown, being at least fifteen pounds per cent. inferior in value to those which are generally cultivated, it is unnecessary to say any thing about them. The second division comprehends the whole varieties of white, under two distinct heads, namely, thick chaffed and thin chaffed. The thick chaffed varieties were formerly in the greatest repute, generally yielding the whitest and finest flour, and in dry seasons, not inferior in produce to the other; but since the disease called mildew, to which they are constantly predisposed, raged so extensively, they have gradually been going out of fashion; under these circumstances, it seems unnecessary to notice them more particularly.

The thin chaffed wheats are a hardy class, and seldom mildewed, unless the weather be particularly inimical during the stages of blossoming, filling, and ripening; though some of them are better qualified to resist that destructive disorder than others. A nomenclature of thin chaffed wheats might be useful, but, at present, any thing of that nature is an impossible task, because, even with agriculturalists, their names are altogether arbitrary. It has often been noticed that this class of wheat preserves a green healthy aspect during the coldest weather, when other varieties assume a sickly, and jaundiced hue. The resistance which it shows to the effects of inclement weather, perhaps proceeds from

the strength of its roots, though the effects may be easier described than the case accounted for. I shall, however, give something in addition, on two sorts of wheat that have lately attracted the attention of agriculturalists, namely, the *Egyptian wheat*, on account of its fecundity, and the *Jones's or Lawler wheat*, on account of the singular properties of resisting the devastations of the Hessian fly.

On the Diseases of Wheat.

Wheat is subject to more diseases than other grains, and in some seasons, especially in wet ones, heavier losses are sustained from those diseases, than are felt in the culture of any other culmiferous crop, with which we are acquainted. Wheat may suffer from the attack of insects at the root; from blight which primarily affects the leaf, or straw; and, ultimately, deprives the grain of nourishment; from mildew on the ear, which operates thereon, with the force of an apoplectic stroke; and from gum of different shades, which lodges in the chaff or cups in which the grain is deposited.

Blight in wheat, originates from moist foggy weather, and from hoar frosts, the effects of which, when expelled by a hot sun, are first discernible on the straw, and afterwards on the ear, in a greater or lesser degree, according to local circumstances.

Mildew again, strictly speaking, may be ranked as a disease which affects the ear, and is brought on by causes somewhat similar to those which occasion blight; though at a more advanced period of the season: These different disorders are generally accompanied by insects which are considered, though without the least foundation, as the authors of the mischief that follows; their appearance, however, may be attributed to the diseased state of the plant.

Another disorder which affects wheat, and which is denominated rust, is brought on by excessive heats, which occasion the plants to suffer from privation of nourishment, and become sickly and feeble: In this atropnical state, a kind of dust gathers on the stalk and leaves, which increase with the disease, till the plant is

in a great measure worn out and exhausted. The only remedy in this case, and it is one that cannot be easily administered by the hand of man, is a plentiful supply of moisture, by which, if it is received before the consumption is too far advanced, the crop is benefited in a degree proportional to the extent of nourishment received, and the stage at which the disease has arrived.

Egyptian Wheat.

The astonishing fecundity of this grain may be gathered from the following experiments:—A. M'Sowler of Lincoln, three years ago planted twenty-five grains of this wheat—the second year's produce was ten bushels; the third year he reaped upwards of forty quarters, part of which he sold shortly after for five guineas per quarter. I am not able to say whether he deviated from the common mode of culture or not.

Mr. Mines's description of the Jones's or Lawler Wheat.

"My wheat was sown about the 10th of October, and grew well, having, as I thought, a little of the purple appearance of rye. When it began to spread and shoot up, about the middle of April, it gradually assumed more and more of what the farmers term the fired appearance. This was occasioned by the two under or ground blades turning yellow, and gradually decaying; the plants, however, grew and shot up with vigor. The two under blades still continued to decline, until they became entirely dead in the early part of May, so that this particular property of the wheat, which at first alarmed me, not being accustomed to the manner of its growth, I believe saves it from the injury of the fly. Upon examination, at the season when they are committing their depredations, the fly will almost universally be found, in its imperfect state, in the two ground blades. Now, if these die before the eggs arrive at any considerable size, they have neither protection nor nourishment, and must of necessity perish. From these facts it may be concluded that *Jones's wheat*, or any

other species of which the under blades die early, will be proof against the Hessian fly. I have never seen nor heard of an instance where the *Jones's wheat* has been injured by the fly, but I have seen every other kind, even sown adjacent, and on the same day, sustain much damage."

On steeping or pickling Seed.

This process is indispensably necessary on every soil, otherwise smut to a greater or less extent will follow; though almost all practical farmers are agreed as to the necessity of pickling, yet they are not so unanimous as to the mode of operation, or of the article best calculated to answer the intended purpose. Stale urine may be considered as the safest and surest pickle, and where it can be obtained in a sufficient quantity, is generally resorted to—the mode of using it does not, however, seem to be agreed upon; for while one party contends that the grain ought to be steeped in the urine, another party considers it as sufficient to sprinkle the urine upon it; some, again, are advocates for a pickle made of salt and water, sufficiently strong to buoy up an egg, in which the grain is to be thoroughly steeped; but whatever difference there may be in opinion, as to the kind of pickle that ought to be used, and the mode of using it, all admit that mixing the wet seed with hot lime, fresh slacked, is of the greatest utility, and in one point of view it is absolutely necessary, so that the seed may be equally distributed: It may be remarked, that experience justifies the utility of all these modes, provided they are attentively carried into operation. There is some danger from the first; for if the seed steeped in urine is not immediately sown, it will infallibly lose its vegetative power. Sprinkling the urine on the seed, seems therefore the safest method if performed by an attentive hand, whilst the last may do equally well, if such a quantity of salt be incorporated with the water, as to render it of sufficient strength: It may also be observed, that this last mode is often accompanied with smut, owing no doubt to a deficiency of strength in the pickle; whereas a single head with smut is rarely discov-

ered when urine has been used: I shall, however, mention three different modes of steeping wheat, each of which have been successfully practised by intelligent farmers. *The first* is, after the wheat is run through a screen, to take out the seeds of cockle, drips, and other weeds, which infest the crop; (care being taken, not to let the seed get any mixture of rye in it, as it considerably lessens the crop;) then wet the seed wheat well, and while it is wet, roll it in gypsum or plaster of Paris, till by reason of the moisture, a complete coat of gypsum envelops the grain, then sow it immediately: this treatment makes the crop grow larger, ripen much earlier, and preserves it from rust or mildew. *The second method* is, to steep the seed in the carbonated liquor afforded by dunghills: It is highly esteemed as a steep, which promotes the growth of the crop, and protects the seed from injury by insects. *The third method*: Let the wheat be thrice thoroughly washed, and let the water drain from it, after the third washing; then steep it eighteen hours, in brine strong enough to float an egg, and spread it on a floor to let the brine run off; but while the wheat is yet wet, let quick lime be equally sifted over it, stirring it very well with a shovel, and continue sifting on more lime, until the wheat be equally dusted with it; in the proportion of half a gallon of lime to a bushel of wheat: By stirring it well with a shovel, the wheat will soon be dry and fit for sowing. The produce of some exceeding smutty wheat prepared for sowing in the above method, has been good, clean, well filled grain.

On Seed Work.

Sowing in the broad cast way may be said to be the mode universally practised, for the trifling deviations from it can hardly be admitted as an exception. Upon well prepared lands, if the seed be distributed equally, it can scarcely be sown too thin, perhaps from a bushel to a bushel and a half per acre are sufficient; for the heaviest crops, at autumn are rarely those which show the most vigorous appearance through the winter months.

Rye.

There is but one kind of rye: but this may be made either *winter* rye, or *spring* rye; by gradually habituating it to different times of sowing. Take winter rye for instance, and sow it later and later, each fall, and it may at length be sown in the spring, and then it becomes spring rye.

Rye ought never to be sown on wet soils, nor even upon sandy soils where the subsoil is of a retentive quality. Upon downs, links, and all soft lands, which have received manure, this grain thrives in perfection, and if once covered in, will stand a drought afterwards, that would consume any other of the culmiferous tribe. The several processes may be regarded as nearly the same with those recommended for wheat, with the single exception of picking, which rye does not require. The winter seeded fields are generally the bulkiest and most productive. It may be succeeded either by summer fallow, clover, or turnips. Even after oats, good crops have been raised.

Barley.

Barley is a dry, husky grain, and requires considerable moisture to cause it to vegetate; it should be sown when the ground is sufficiently moist; it should also be sown as soon as the ground can be well prepared in the spring. This grain receives essential benefit from being soaked in ley, brine, or some other fertilizing liquor. An English writer mentions an experiment some years ago, which may be worth inserting:—The spring being very dry, he soaked his seed barley in the black water taken from a reservoir which received the draining from his dung heap and stables. As the light corn floated on the top, he scummed off, and let the rest stand twenty-four hours. On taking it from the water, he mixed the grain with a sufficient quantity of wood ashes to make it spread regularly, and sowed three fields with it. The produce was sixty bushels to the acre. He sowed some in other fields, with the same dry seed; but the produce was very poor in comparison

to the other. Adding some saltpetre to the liquor in which the barley is soaked, will greatly increase its virtues. Barley may be divided into two sorts, *early* and *late*, to which may be added a bastard variety called *bear* or *big*, which affords similar nutriment or substance, though of inferior quality. Early barley, under various names, was formerly sown upon lands that had been previously summer fallowed, or were in high condition; but this mode of culture being in a great measure renounced, the common sort, which admits of being sown either early or late, is now generally used. The most proper season for seeding this grain is any time in the month of April, though good crops have been produced when it has been sown at a much later period. Bear or big may be sown still later than common barley, because it ripens with greater rapidity; but, as a general principle, where land is in order, early sowing, of every variety, is most desirable. The quantity to be sown of this grain, may be from one bushel and a half to two bushels to the acre, according to the quality of the ground and the richness of the soil.

Oats.

Of oats there are ten species that are known in England, the names of which are, the naked oat, or pilcorn; the bearded, or wild oat; the rough, downy, or hairy oat; the yellow oat; the meadow, or yellow leaved oat; the common oat; the skegs oat; the Tartarian, or reed oat; and the Friesland and Poland oats; of which that called the sativa, or common oats, is most generally cultivated. This species thrives almost on any soil, and being extremely productive on land newly broken up, it is eminently adapted to most parts of the United States. It is divided into three varieties, namely:—

1st. The white oats, which are the most valuable, and require a soil somewhat drier than that for the other species. This variety is chiefly cultivated in the southern counties of England.

2d. The black oats, which are principally raised in Scotland and the northern counties of England. For feeding cattle, they are of equal quality with the white

oats, though not affording so sweet a meal for culinary purposes as the white oats.

3d. The brown, or red oats, produces good meal, ripens somewhat earlier than either of the two preceding varieties, and does not shed its seed. It is chiefly cultivated in the north-western parts of England for feeding. All these varieties are propagated from seed which may be sown from the first of April till the middle of May, in the proportion of from two to two and a half bushels to the acre, broad cast. It is sometimes sown with grass seeds, such as clover, ray grass, &c. The management of this kind of grain does not materially differ from that of barley, rye, &c. Oats have in some instances been both dibbled and drilled; but as this method has not come fully into practice, its utility has not been fully ascertained; there is but little doubt, however, but that either method, if properly conducted, would be preferable to the broad cast sowing. The last mentioned species, or that called the sativa, or common oats, is raised on account of its farinacious properties. The grain is given to horses, for which it affords a very strengthening food, and, before barley came into general cultivation, it was converted into malt. The meal is made into cakes, biscuit, &c. or boiled into a kind of pottage. Its straw is also usefully employed in feeding cattle when mixed with potatoes.

Buckwheat

Is the next in order of the culmiferous tribe that is to be treated of. This grain will grow with more indifferent culture than almost any other kind. It should be sown at such time as it will just ripen before the fall frosts are usually to be expected. The product of this grain depends much on the weather, while the growing crop is in blossom, for if the days are moderately cool at that time, it may be expected to fill well and be abundant; but it may be otherwise, should there be much warm weather at that time. Sixty and seventy bushels to the acre are sometimes raised of this grain where the growth is sufficiently thick and heavy on the ground. It is considered excellent for bees while the crop is in

blossom. It may be cultivated yearly on the same ground, and to considerable advantage, on light lands of no great value, but which are suitable to gypsum as a manure. When ground and boiled it is excellent for fattening hogs. About three pecks of this grain is sufficient to seed an acre of land, and less if the land be rich.

Indian Corn.

I deem it unnecessary to give the practical farmer any directions for preparing his land for Indian corn, as I am aware it is sufficiently known to himself. I shall, therefore, confine myself to the choice of seed and the vegetating steeps necessary to promote its early growth and prevent the devastation occasioned by the cut-worm. Always select the best and largest ears of corn, and such as ripen first on the stalk; gather them by pulling off the ear, husk and all; hang them up where no wet will come to them, and let them thoroughly dry. By taking the first corn that ripens, where there are two ears on a stalk, for seed, you will have your crop earlier by ten days or a fortnight the following year, and your crops considerably increased.

1st Steep.—Take one peck and a half of fresh and dry wood ashes, and one peck of unslacked lime, which put into a tub that will contain about 40 gallons of water; then add as much water as will slack the lime, and render the mixture *(which should be well incorporated)* into the consistence of a stiff mortar. In this state it should remain ten or twelve hours. Afterwards add as much water as will reduce the mortar to a pulp, by stirring; then fill the tub with water, which must be stirred for two or three days; then draw off the clear ley into a proper vessel for steeping the grain, and gradually put the grain into it, skimming off the light grain that swims on the surface. After it has been steeped let it be taken out and spread on a floor to drain; when well drained, roll it in plaster of Paris, and plant it immediately.

2d Steep.—Dissolve saltpetre in water so as to make it very strong; soak your seed corn therein until it be-

comes swelled; then plant it in the usual way, taking care not to let it be long out of the brine before it is covered It will produce three times the crop, and will be ripe sooner than the same sort of corn planted without soaking, on ground of the same quality.

3d Steep.—Take 4 lbs. of soot; 2 ounces of succotrine aloes, powdered; ½ lb. of gun powder, and 4 quarts of plaster of gypsum: soak one bushel of corn in the soot and a sufficiency of water to make the corn sprout: then add the powdered aloes and gun powder; then roll it in plaster, and plant it moist. This not only prevents the worms, birds, ants, &c. but adds greatly to the vegetation and growth of the plant, by a chymical decomposition of the atmosphere, or gasses surrounding it, and by producing moisture of a nitrogene quality, whilst the hydrogene quality of the sulphur, carbon, and nitre, combines and acts in defending the plants from the coolness of the spring season; and when the weather becomes hot, a decomposition of an alkaline nature is produced, that in good ground is equal to a coating of horse manure.

4th. Some farmers make a steep with warm water, sufficient for a bushel of corn, into which they pour three pints of tar, and soak the corn in this solution eight hours; after taking it out and letting it drain, they roll it in plaster of Paris or wood ashes, and plant it immediately. Though this steep guards the corn from the depredations of the black birds, it is longer in coming out than corn steeped in any of the foregoing methods, owing principally to the stiptic quality of the tar.

Potatoes.

This valuable esculent is a native of South America, and was first brought to Ireland by that renowned navigator, Sir Walter Raleigh, in the year 1565. When first planted by the Irish, they knew so little of the mode of culture and the maturing progress of the seed sown, that, instead of turning up the ground, *(as reason and experience teaches,)* they pulled off the small round apples that hung on the stalk, and, after cooking them, they found them so bitter that they threw them

away, bestowing their hearty and sincere maledictions on Sir Walter for being the cause, as they then thought, of so much unnecessary and profitless labor; but how great was their surprize the next spring, when upon opening the ground to fit it for the cultivation of other crops, to which their limited knowledge of agriculture then confined them, to find hidden in the soil, *in a manner inviting their researches and stimulating the exercise of their searching powers*, a crop so much beyond their expectation? They have since, however, made ample amends for their want of knowledge.

When we consider potatoes as an essential article, contributing their alimentary properties to the support of human nature, and as an article of food, next to wheat, of the greatest importance, it is both necessary and proper to illustrate the culture of this valuable esculent, through its various stages, till the crop is dug up and ready for market.

Preparing the ground for culture.—Potatoes require a rich loam, and not too moist. Wet land produces too much top, and watery fruit strong to the taste, and not good to keep through winter. Very dry land produces a small crop and knotty fruit. Land that is apt to break should also be avoided. For this crop the earth should be well ploughed, and kept free from weeds,* and should not be shaded; the principal error, however, in cultivating potatoes, is too much hilling. If planted in a suitable soil, they will always bed themselves at that depth most suitable to their growth, which is about four inches. If you are necessitated to plant them upon a hard bottom, a little hilling may be useful. It has, no doubt, been observed by most people who cultivate potatoes, that if the tops are partly covered with earth, small potatoes will grow upon them; this hinders the growth of the first crop. If the seed potatoes are not cut in pieces, but planted whole, and in cross rows, the hills should be about thirty inches from each other; and in this case, the dung should be collected more together at the places where the potatoes are to be laid. When the plants have risen about six inches above ground, it is to have a good harrowing across the rows, and the hoe is to follow for the purpose of setting the plants right, where cover-

ed, and drawing some earth round them. In due season, a furrow, with the one horse plough, is to be run on each side of the rows, with the earth thrown up to the plants, which is to be followed with the hoe, which completes the process for raising the crop. If any weeds should afterwards rise, they should be cut up with the hoe, so that none be allowed to go to seed in the fall.

As soon as the blossoms appear, they should all be taken off, which will increase the crop considerably. To increase your stock of potatoes and obtain excellent kinds, take of the balls that hang on the stalk, when ripe in autumn, open them and dry the seed in the sun, so that they may be preserved through the winter; place these in good mellow ground in the spring, and keep them clear of weeds, &c. The first year's produce will be small: take of the largest of these, and the best kinds, to plant the following year, and your potatoes will be much improved and of great variety. If you wish to have early potatoes, put the potatoes you intend to seed in a bed of rich clay and sand, in a warm room, on a boarded floor, till they begin to sprout, and after they send forth shoots three or four inches long, transplant them into beds previously prepared for them, taking care that you neither break the sprouts nor cover them up entirely, but set them with the sprouts perpendicular, and leave a half an inch of the top uncovered. By this method you can have potatoes ten weeks earlier than by following the usual mode of cultivation.

Flax.

It is almost needless to descant on the valuable properties of flax: its utility is well known as an article, when manufactured, promoting both health and cleanliness. I shall therefore give the best directions for its culture, and management preparatory to spinning.

Flax is not a severe crop on the soil when pulled green as it ought to be if an article of good quality is wished for; though, when allowed to stand for seed, it is as severe a scourge as can be inflicted. The soils most suitable for flax, besides the alluvial kind, are deep, and

friable loams, and such as contain a large proportion of vegetable matter in their composition. Strong clays do not answer well, nor soils of a gravelly or dry sandy nature, but whatever be the kind of soil, it ought neither to be in too poor, nor too rich a condition; because in the latter case the flax is apt to grow too luxuriant, and coarse; and in the former case, the plant, from growing weakly affords only a small produce. When grass land is intended for flax, it ought to be broke up as early in the season as possible, so that the soil may be duly mellowed by the winter frosts, and in good order for being reduced by the harrow, when the seed process is attempted. If flax is to succeed a corn crop, the like care is required to procure the aid of frost, without which the surface cannot be rendered fine enough for receiving the seed: Less frost, however, will do in the last than in the first case: therefore the grass land ought always to be earliest ploughed. At seed time, harrow the land well before the seed is distributed; then cover the seed to sufficient depth; water furrow the land, and remove any stones and roots that may remain on the surface, which finishes the seed process. Keeping flax unwatered till the next spring, is attended with many bad consequences; for when too much dried by long keeping, it is not so easily nor so safely watered; the quality of the flax is harsher and it is subject to danger from vermin, and other accidents during the winter; the water in the spring or beginning of summer, is not so soft and warm, as in harvest, and near a year is lost, of the use of the lint, by the practice of keeping it over winter.

When a crop of seed is intended to be taken, thin sowing is preferable, in order that the plant may have room to fork or spread out the leaves, and to obtain air in the blossoming, and filling season; but it is a mistake to sow thin when the flax is intended to be taken, for the crop then becomes coarse; and often unproductive. From six to ten pecks per acre is a proper quantity.

Method of Watering Flax.

When flax is pulled, it ought to be immediately put into the water, so that it may part with the rind or shove, and be fit for the manufacturer. Standing pools, for many reasons, are most proper for the purpose, occasioning the flax to have a better color, to be sooner ready for the grass, and even to be of superior quality in every respect. When put into the water it is tied up in beets. Twelve days will answer in any sort of weather; though it may be remarked, that it is better to give rather too little than too much; as any deficiency may be easily made up by suffering it to lie longer on the grass, when an excess of water admits of no remedy.

It ought to be also observed that lime water will not answer for rotting flax: water from coal or iron is very bad for flax; a little of the powder of galls thrown into a glass of water, will immediately discover if it comes from iron by turning a dark color; more or less tinged, in proportion to the quantity of that mineral it contains.

Insects.

Immense numbers of these prey upon the labors of the farmer, against the ravages of which it is, in many instances difficult to provide adequate remedies; such, however, as have been discovered, shall be noticed: as I shall say something of the different kinds of those insects which are found most troublesome.

Some vegetables are offensive to all insects, such as the elder, especially the dwarf kind; the onion, tansy, and tobacco, except to the worm that preys on that plant. The juice of these may therefore be applied, with effect in repelling insects, and sometimes the plants themselves, while green, or when reduced to powder, particularly the latter, when made into snuff.

Set an onion in the centre of a hill of cucumbers, squashes, melons, &c. and it will effectually keep off the yellow striped bug, that preys upon those plants while young. No doubt a plant of tobacco, set in the same way, would answer a similar purpose, or perhaps to sow a few tobacco or onion seeds in the hill, when

planting, would have the same effect; and the growing plants from these seeds could be taken away, when no longer wanted as protectors.

Of other substances, sulphur is perhaps the most effectual as every kind of insect has an utter aversion to it. Powdered quick lime is deadly to many insects, and perhaps offensive to all. The same may be observed of soot, wood ashes, and other substances which are strongly alkaline; and also of common salt finely powdered, brine, old urine, &c. Calomel is also deadly to insects, and camphor and terebinthine substances, are offensive to them. After premising thus much, I shall now speak of insects seperately, and begin with the

Canker Worm. The female of this insect comes out of the ground very early in the spring, and ascends the tree to deposite her eggs, which she does in suitable places in the bark; where they are brought forth, and the young brood live on the leaves of the tree. The only effectual remedy is, to prevent the insect from ascending the tree; and this can be done in various ways; but the easiest perhaps as follows:

First scrape off the shaggy bark round the body of the tree, to the width of two or three inches; then make up a mixture of oil, or blubber, with suitable proportions of sulphur and Scotch snuff; and with a brush lay this on the scraped part, forming a ring round the tree an inch or two wide, and no insect will ever attempt to pass this barrier, as long as the composition has any considerable moisture left in it. Let it be repeated when it inclines to harden, though perhaps this is not necessary. Let it be done early in the spring, before the insect comes from the ground.

Another method, which it is believed will be found equally effectual, though attended with more trouble, is to scrape off the shaggy bark from the body of the tree, and then whitewash the part well with lime and water, and a little sulphur added. In place of this may be taken a composition of old urine, kept some time for the purpose, soap suds, and fresh cow dung. Let this be laid on plentifully, and it will keep off all insects.

Another method of preventing the depredations of insects, is to fasten a strip of sheep skin, with the wool

outwards, round the body of the tree, taking care that no place be left for the insect to creep up between the strip and the bark. The wool should be frequently combed to keep it loose. A streak or ring of tar made round the body of the tree, is also effectual, as long as the tar remains soft; but, as it soon becomes so hardened on the exterior that the insect can crawl over, it requires to be repeated very frequently. Perhaps a ring of tar and oil or blubber, mixed together would answer better. Lastly, a strip of oiled paper put round the tree, with the lower edge projecting out considerably, forms a barrier which the insect cannot pass; let the lower edge of the paper be well oiled.

In regard to all insects which are injurious to trees, by climbing them, and committing depredations on them in various ways, it is believed that by taking the earth away from the roots of the trees, very early in the spring, and destroying whatever may appear to be the abode of any insects, and returning the earth back, mixed with a small quantity of sulphur, sprinkling some of this upon the surface, will keep any insect from ascending any such tree. The effect of sulphur, for this purpose, is very durable. Probably one operation of this kind will last for several years; though on this point I have no particular information. Other repellants of insects may be found repellants only for a time; more or less limited; but perhaps may answer the purpose for one spring; such as quick lime, fine salt, old urine, strong soap suds, a strong decoction of tobacco, onions, &c &c. Let either of the four last mentioned ingredients be applied, boiling hot to the roots, after first taking the earth away as first mentioned.

Curculio.—This is a bug about the size of that which eats into the pea, and has proved very troublesome to most of the smooth skinned stone fruits, and even to peaches, apples, and pears, in different parts of the country contiguous to Philadelphia. It has also made its appearance about Albany. It ascends the trees in the spring, and as the fruit advances it makes a wound in the skin and there deposites the embryo, from which a maggot is first produced. This preys upon the fruit until it dies and falls off, when the maggot makes its

way into the earth, and is there changed into a bug which is ready to ascend the tree next spring and make its deposit as before.

Another method of keeping insects from trees, is to tie a small bag of common salt round the tree. A ring put round the tree, of a mixture of grease or blubber, mixed with salt, and some of the other ingredients would answer a better purpose, and be attended with less trouble.

A method of preventing the decay of the Peach Tree.—Take away the dirt from around the root, and where you find gum issuing out, there you will also find a white maggot, which is carefully to be taken away; then wash the body and roots with strong brine, which ought to be repeated now and then in the spring and summer.

I shall mention two other methods which are said to be infallible for keeping insects from trees. One is to bore a hole in the body of the tree, and fill the hole with mercurial ointment, and cork it up tight. The other is to bore a hole in the north side of the tree, and fill it with spirits of turpentine, and cork it up as before. Where the latter article is put into the hole, it should be bored slanting downwards to keep the liquor from running out before the cork can be put in.

Caterpillars—The foregoing directions for keeping canker worms from trees, are equally applicable to these insects.

When a nest of these is formed, run a pole into it, twist it round till the nest and its contents are wrapped round the pole, and bring the whole down and kill the worms. Let this be done early in the morning, when the worms are all in the nest. If any escape this operation, repeat it when they have rebuilt their nests.

Where the nests have been suffered to remain till the insects have left them, young broods for the ensuing year, will, the next spring, be found on the trees in chrysalis state, under the shelter of a dry curled leaf or two, bound with filaments like cobwebs; these should be searched for and destroyed.

It is said that caterpillars take shelter under woolen rags, when put on trees where they resort, from which they can be easily taken and destroyed.

Grubs, or large maggots from the eggs of a species of butterflies, very injurious to Indian corn, while young, by eating the roots. Frequent ploughings, manuring the land with lime, soot, ashes, or salt, all tend much to keep them out of the soil. Most of the articles before mentioned as being offensive to insects, either boiled in or diluted with water, and that applied to the hills, especially just before a rain, will quickly drive the grubs away.

Top, or Spindle Worms, are white worms, resembling grubs found in the central hole which is formed by the leaves of Indian corn, and they there eat off the stem which forms the top of the plant. They are mostly to be found near barn yards and in rich spots. They are discovered by their excrement appearing on the leaves, Sprinkling the corn with a weak ley of wood ashes will extirpate them.

Black Worms, or ash-colored worms, with black stripes on their backs, when full grown—they are of the thickness of a goose quill, and about an inch and a quarter long; they hide in the soil by day, and commit their depredations by night. They eat off young plants above ground, and frequently endeavor to draw them under. It is said that manuring the ground with salt, will drive them from it, and that lime and ashes will have nearly the same effect.

Red Worms.—These are slender, about an inch long, with a hard coat and pointed head. They eat off wheat, barley, and oats, above the crown of the roots, and they also eat through turnips, potatoes, &c. No adequate remedy is known, unless manuring with the manures as before mentioned, which are offensive to all insects; summer fallowings are also recommended, as depriving them of their requisite food.

Palmer Worms—About half an inch in length, with many legs, and very nimble. They give to apple trees the same appearance that the canker worm does. They let themselves down from the trees by threads, similar to the spider. No adequate remedy is known.

Timber Worms.—The smaller kind merely eat into the sap of wood, and turn it into powder post as it is called. Felling timber about the middle of winter, the

time when it has less sap in it, will obviate this difficulty. The large *Boring Worm* takes its residence chiefly in pine timber. They are hatched in the cavities of the bark, and being small when they enter the wood, they grow larger as they proceed, till their boring may be heard at a considerable distance. If the trees be scorched in a light flame or steeped in salt water, it will destroy these worms, or prevent their entering the wood.

Hessian Fly—Well known for its ravages in wheat. Remedy: Immerse the seed wheat ten or fifteen minutes in boiling hot water, cool it suddenly, dry it, with lime or gypsum sprinkled upon it, and sow it immediately. This process will assist its growth, in addition to its killing the nits of the fly, which, by a good glass, are discernible near the sprouts of the grains that are infected. This remedy stands well attested by several publications, and is believed to be effectual.

Maggots—Troublesome to the roots of cabbages, turnips, and radishes. Remedy: Give the ground a previous manuring with salt, which will be found effectual. Some weak brine applied to the roots of the plants just after a rain, is also recommended. It should not be too strong, lest it injure the growth of the plants.

Yellow-striped Bug, formidable to the young plants of cucumber, &c. In addition to what has already been said of the remedies for keeping off these intruders, I would recommend sprinkling the plants with a little sulphur, or Scotch snuff, which will be found very efficacious.

Turnip Fly.—This insect eats the seed leaves of the young turnip plants, and thus destroys them. Sowing a suitable proportion of tobacco seed with the crop will no doubt answer every purpose for keeping off this insect; but as common salt is found to be an excellent manure for this crop, I would recommend about three or four bushels of this article, made fine, with as many pounds of sulphur, and perhaps a pound or two of Scotch snuff, well mixed together, to be sown on the ground just as the plants are coming up, and this I can venture to say, will be found effectual in keeping off these insects. A flock of ducks let into the turnip field is also very good, as they will destroy the insects without injuring the plants.

Garden Flea—Very destructive to young cabbage plants while in the seed leaf. Remedy: Sow some onion or tobacco seeds with the seeds of the plant, or sprinkle some sulphur or snuff on the growing plants. Soap suds sprinkled over them is also good.

Lice.—These infest cabbages particularly, but are destroyed by the frosts. They are easily extirpated by smoke, particularly that of tobacco.

Weevil—A little black bug, very destructive to wheat, either in barns or granaries. On thrusting your hand into a bin of wheat infested with them, considerable warmth will be felt; but as they are usually collected together, every part of the heap or bin should be examined. There are various ways of keeping wheat clear of this insect after it has been threshed out and put in bins. It is found that sprinkling of lime with wheat, infested with them in the bins, will soon drive them away. The lime can be afterwards winnowed out. Sulphur or snuff, put up in little papers or bags, and properly distributed among the wheat in the bin, will keep them out, or drive them out when they have got possession. A plant of herbane has the same effect, and so has the leaves, and wood of the Lombardy poplar—a bin made of boards of this wood will never have a weevil in it.—Take wet linen cloths, and lay them over a heap, or bin of wheat, with weevil in it, and they will soon come out of the wheat, and get upon the cloths, when, by dipping these in water again, the insects are readily destroyed. It would seem that the readiest way to keep them out of mows of wheat before threshing, would be to mix little pieces of the Lombardy poplar every where through the mow in laying the sheaves away. Perhaps common salt is as offensive to this insect as to most others; and if so, to sprinkle some among the sheaves when laying them down, might answer a double purpose of keeping out the weevil and improving the straw for fodder.

Grasses.

The great improvements that are made by sowing land in tillage with grass seeds, do more encourage the

use thereof, and especially those of clover, trefoil, sanfoin, and lucerne, to which may be added timothy, because the harrowing in of grain upon only one ploughing saves a great expense and time, besides the produce of large crops, and as some of these grasses will suit all soils.

Clover.

This grass grows well on dry soils. About ten or twelve pounds of seed are requisite for an acre. It is of great improvement to land, and most excellent food for cattle, either in grass or hay; and the riches by which it impregnates the ground, by the stalk and roots, the former by receiving the nitrous dews, which descend by them to the roots and ground about them; the latter also affords a sort of dressing to the ground after it is ploughed up; and, above all, saves that expense which many are at yearly for weeding their ground, which is by this grass entirely got under.

White Clover.

This grass grows spontaneously on dry uplands, after they have been manured with gypsum, or with bog marle, &c: it is a very sweet grass for pasture or hay, but not very productive; it is generally short lived, but may be made to last longer, by passing a roller over it; for where the stalks come in close contact with the ground, new roots will start and descend into it: It is most useful in mixing with other grasses, for the purpose of thickening the growth of the bottom, and thus increasing the product.

Trefoil.

Lands naturally kind for grain, and unkind for common grass, are undoubtedly kind for trefoil; and though it be so much impoverished by long sowing, that it will bear grain no longer, it will bring a crop of this grass. Experience convinces me that it will grow in any soil; even rocky, hilly, or gravelly ground, of a very small

value, may be improved by this grass; but if the land be a clay, and it lays wet, it must be drained, and made as dry as possible. That the pasture is as good and better on trefoil than clover, for cattle, and especially cows; for it will not only cause them to give more milk in quantity, but better in quality, and also makes butter and cheese of a delicate yellow colour: The hay thereof is nourishing, if it is made in good season: The quantity of seed to be sown per acre, is, if in the hull, two bushels; but if the seed is naked and clean, from ten to twelve pounds is the quantity per acre; or if sown with clover half of each.

Saint Foin, or Holy Hay,

Which name is derived from its excellent nutritive quality.

There may be more benefit reaped from this grass, than any other; as it produces great crops on the driest land, on hills, gravels, sands or even barren ground; and it will so improve all those lands in such an extraordinary manner, that they will bring great crops of any sort of grain after it.

The quantity of seed, for sowing broad cast is two bushels to the acre, and for drilling one bushel.

Luserne,

Is the same plant which the ancients were so fond of, under the name of Medica: Its leaves grow three at a joint, like those of the clover; its flowers are blue, and its pods of a screw like shape, containing seeds like those of the red clover.—It is the only plant in the world, whose hay is equal to the saint foin for the fattening of cattle: It is the sweetest grass in the world, but must be given to cattle with caution, and in small quantities; otherwise they will swell, and incur diseases from it. The plants should stand five inches distance in single rows, and the intervals between these rows must be left for the use of the hoe plough; but if hand hoed one foot between the rows will do; from one pound and a half to two pounds, will be enough of seed for an acre.

Timothy Grass,

Is a species of grass something like rye grass; and makes the best hay, and the greatest quantity of any known at present in this country: it is supposed to be indigenous to this country. The best time for sowing the seed is from the middle to the latter end of August: A moist, rich land will produce from two to four tons per acre; one peck of clean seed is sufficient to sow an acre; some sow it with grain; but the best method is to sow it by itself.

Lupenella,

A small quantity of this seed was sent by a gentleman from Leghorn, in Italy, to the governor of Georgia: the following is the account of this valuable grass sent with the seed:

It is represented as the finest grass cultivated in that country, for the quantity and richness of the hay; the preference felt for it by all animals; and its fertilising effects upon the land in which it is cultivated In Italy, it is sown in March and October; it is cut with a sickle to avoid shaking off the blossoms; bound up in bundles of 7 lbs. and fed to working beasts without grain, as it is sufficiently nutritive of itself.

Three years cultivation of this grass enriches the poorest land so much, that two successive and abundant crops of grain are produced without manure. It is generally sown broad cast, but drills will be more productive for seed.

When sown for hay, it ought to be sown thick, as a certain means of keeping the crab grass under.

DYING.

To dye Silk, Linen, Woollen, Cotton, Bristles and Feathers all kinds of colours, with the proper Mordants for fixing the colours, with directions for making Bran and Alum Water, Iron Liquid, &c.

THE art of dying is so useful in a country like America, that to say any thing in its favor is entirely useless, as its utility is sufficiently known to the most superficial observer.

The essential point, in colouring, is a knowledge of the means of setting the colours so permanently that they will never fade. In cottons, this is often a matter of difficulty; in woollens it is less so. The liquid or substance used to set colours, is called the mordant. The proper mordants for blues and for scarlet, or red of various hues, is the solution of tin, and is prepared in the following manner:—

Take two parts of spirits of nitre, one of fuming spirits of salt; in this liquor dissolve one twentieth part of its weight of the purest tin that can be had, or more if the liquor will dissolve more. The tin is to be granulated, *which is done by melting it, and pouring it whilst hot into water*, and put in by degrees as the liquor dissolves it. To use this mordant, dilute it in two or three parts of clear stream water, according to its strength, until it has the acidity of vinegar or lemon juice.

To make Bran Water.—Take half a peck of wheat bran and two gallons of rain water; put them on the fire, and give them a gentle heat; then put half a pound of alum powder into it, and suffer it to stand a week or more, stirring it every day during that time. If a larger quantity is wanted, it can be made in the above proportion.

Alum Water.—Take one pound of alum; bruise it and put it into two gallons of water till it is dissolved, adding a small piece of gum Arabic; and after giving it a gentle heat, scum it from froth or scurf; strain it and keep it for use.

I shall now give a list of different substances, with the mordant proper for each, as far as I have been able to obtain a knowledge of; and which, on account of their cheapness, and the ease with which they can be procured, will be found extremely useful:—

Vegetables.	*Colours.*	*Mordants.*
Indigo, - - -	Blue, -	Solution of tin,
Woad, - - -	do. -	do.
False indigo flowers, -	do. -	do.
Blue whortleberry fruit,	Mazarine blue,	do.
Pokeweed fruit, -	Tyrean purple,	do.
Winter grape fruit, -	Violet,	do.
Common hazel nut husks, green, - - -	Black,	Copperas.
Hickory nut husks, green,	do.	do.
Witch hazel nut husks, green, - - -	do.	do.
Sumac bark, - -	do.	do.
Oak trees, bark, -	Steel,	do.
Maples, bark, - -	Purple,	do.
Walnut trees, bark, -	Olive and brown,	do.
Sassafras bark, - -	Red,	do.
Madder roots, - -	do.	do.
Persimmon tree bark, -	Crimson,	Alum & salt of tartar.
Locust tree bark, -	Yellow,	do. do.
Poplar tree bark, -	do.	do. do.
Peach tree and arsesmart leaves, - -	do.	do. do.
Stone fruit trees, bark, -	Nankeen & cinnamon,	do. do.

The mordant is to be used in two ways: Where it gives no colour of itself, the cloth or yarn may be put into the mordant a suitable length of time, and then put into the dye; or a suitable proportion of the mordant may be mixed with the dye; but where the mordant gives a colour of itself, the cloth or yarn should first be put into it, and then into the dye. Thus, for dying cotton black, the mordant commonly used is a boiled decoction of fustic, which of itself gives a yellow colour; but, after having received this, will receive a permanent black dye. The bark of the quercitron or American black oak, will answer the same purpose.

Of Scarlet Dying.

Scarlet dying, in general, is a distinct and separate branch of trade; the materials being of that delicate kind as easily to be injured by any accidental admixture of other colours, and part of the apparatus being somewhat different from common dying, the boiler in which the cochineal bath is made, is generally of tin or strongly tinned copper, because a solution of tin is the mordant used in the process, and therefore no mischief can arise from its being in contact with the same metal. The water made use of must be soft and pure, hard water having a tendency to produce a rose colour, which, however, is corrected by boiling bran or starch in it. The infusion of cochineal is naturally of a fine crimson, and with a mordant it fixes on woollen and silk with great firmness, but weakly and with considerable difficulty on linen and cotton. Alum was the first mordant employed to fix the colour of cochineal on wool. It sensibly alters the natural tint, and gives a deep and durable crimson. It will even restore the crimson to cloth dyed scarlet by the compound tin mordant. The effect of tin in heightening the colour of cochineal was discovered by a German chymist named Huster, who settled at Bow, then in the vicinity of London, in the year 1543, and on this account is called the Bow dye there.

The vessel wherein purple is dyed ought to be of pewter.

To prepare raw Silk.

Take the silk and put it into a bag that it may not entangle, then to every pound of this silk add ¼ lb. of soap Let this boil together two hours; then take it and cleanse it well; them put it in alum water, and it is ready.

Another.

Take the silk thread, and to every pound put a quarter of black or green soap; then smear it well all over the silk; put the silk so smeared into a linen bag; let it boil six or seven hours;; then take the bag of silk out of the water and let it cool, and rinse it in river water 15 minutes, wring the water well out of it, and then rinse and dry it again. Observe that this process is absolutely necessary for all raw silks before they can be dyed.

How to Alum the boiled Silk.

Take a quarter of a pound of alum to every pound of silk; melt it in a skillet and throw it into a sufficient quantity of water to cover the silk—say 2 quarts to every quarter of a pound.

To dye Silk or Worsted a fine Carnation colour.

First take to each pound of silk four handfuls of wheat bran, put it into two pails of water and boil it; pour it into a tub; and let it stand all night; then take half the quantity of that water, and put into it half a pound of alum, a quarter of a pound of red tartar in powder, and half an ounce of finely powdered turmeric: boil them together, and stir them well about with a stick; after they have boiled a quarter of an hour, take the kettle off the fire; put in the silk and cover the kettle close, two hours; then rinse the silk in cold water; beat and wring it on a wooden pin, and hang it up to dry; then take one-fourth of a pound of powdered nut

galls, and put the powder into a pail of river water; boil it for one hour; then take off the kettle, and when the hand can be borne in it put in the silk and let it lie an hour; then take it out and hang it to dry: when the silk is dry take to each pound of silk three quarters of an ounce of cochineal in powder; then put it in the pail with the remaining ley. and having well mixed it, pour it into a kettle; when it boils cover it well to prevent any dust from falling into it. After this, put in three-fourths of a pound of alum, and two and a half ounces of tartar, both finely powdered; let it boil for a quarter of an hour, then take it off the fire; let it cool a little; and put in the silk; stir it well with a stick to prevent its being clouded, and when cool wring it out. If the colour is not deep enough, hang the kettle again over the fire, and when it has boiled and is grown lukewarm again, repeat the stirring in of the silk; then hang it upon a wooden pin fastened in a post, and wring and beat it with a stick; after this rinse the dyed silk in hot ley, wherein to one pound of silk is dissolved one ounce of pure white soap; afterwards rinse it in cold water; hang the skeins of silk on a wooden pin, putting a little hand stick to the bottom part; and thus having worked it, wring it and beat it round, and hang it to dry.

Another Crimson for Silk.

Take of good Roman alum, powdered, half an ounce, sulphuric acid one quarter of an ounce: put them into a pewter kettle, and pour as much water as is sufficient for half a pound of the silk you purpose dying; when it is ready to boil put in the silk, *which must be before boiled in bran water;* boil it for an hour or more; then wring it out, and put to the liquor half an ounce of cochineal, finely powdered, and sixty drops of sulphuric acid; when ready to boil put in the silk again, and let it soak for four hours; then take clean water, drop into it a little of this acid, rinse therein the silk; take it out again and dry it on sticks in the shade. This will be a high colour; but if you would have it of a deep crimson, take, instead of sulphuric acid, pure water of ammonia to rinse the silk in.

General observations on Dying Crimson, Scarlet or Purple.

The boiler or kettle must be of good pewter, quite clean, and free from any soil or grease. 2d. The prepared tartar must be put in when the water is lukewarm. 3d. If you intend to dye woollen or worsted yarn, you may put in the first boiling, and let it boil for two hours. 4th. When boiled take it out, rinse it, clean the kettle, and put in the water for the second boiling. 5th The second boiling is performed in the same manner as the first; then put in the cochineal, finely powdered; when it boils stir it well about. 6th Now the silk, which has been washed and cleaned in the first ley, is to be put in, on a winch, which is continually turned about in order to prevent the colour from fixing in clouds 7th. When the colour is to your mind, take it out, rinse it in clean water, and hang it up in a room or shady place, where it may be free from dust. 8th When the acid is put into the second boiling, it causes a coarse froth to swim on the top, which must be carefully taken off.

Another Crimson for Silk.

When the silk is well boiled, to every pound thereof take of crude alum 8 ounces; when it is dissolved lay the silk in the liquor all night; the next day rinse it well, and then prepare the dye as follows: Take a kettle of clear water, and to every pound of silk put in 2½ ounces of cochineal, finely powdered, 3 ounces of galls, finely powdered, 3 ounces of purified gum, and one drachm of turmeric; boil the silk in this liquor 2 hours; after this let it remain 12 hours; then wring and dry it.

Cheap Red.

To every pound of silk take one pound of Brazil wood; shave the wood into small pieces; then put it in water and boil it; then wave or turn the silk about in it till it has sufficiently taken the colour; then add a little pot ash to fix the colour, and then rinse it in fair water and dry it.

An easy method of dying Cotton with Madder as practised in Smyrna.

Boil the cotton in common olive oil, or in some other pure vegetable oil, and afterwards in mild alkali; when it is thus cleansed, it will take the madder dye. This is the mode of procuring the fine colour so much admired in the Smyrna cottons.

For a deep Turkey Red or Scarlet.

Take two ounces of cochineal and one pound of red saunders wood, and one pound of madder, four ounces of alum, and one ounce of red arsenic; boil all together three hours, leaving five gallons of the dye in the kettle; put the cotton in the dye one hour. This quantity is for 5 lbs. of deep Turkey red in cotton, and 4 lbs. of scarlet in woollen.

To dye 100 lbs. of Wool or Woollen Cloth Scarlet.

Take 8 or 10 lbs. of tartar; put them into the boiler with a sufficient quantity of soft water, and 6 or 8 ounces of cochineal; afterwards 10 or 12 lbs. of the nitre muriate of tin are to be added; and when the mixture is ready to boil, the cloth previously wet is put into the dying liquor, turned through it by a winch for an hour and a half, the liquor being kept boiling the whole time; the cloth is then taken out and rinsed, and found by this first process to have acquired a flesh colour; the boiler is now emptied and filled again with fresh water, and when nearly boiling from 5 to 6 lbs of cochineal are thrown in and well stirred; after which 10 lbs more of the solution of tin are added, and the cloth then put in and turned through the boiling liquor, at first briskly and then slowly for half an hour; it is then washed and dried in the usual manner. The proportion of cochineal to dye a full scarlet is an ounce to a pound of cloth, hence, from the high price of this article, the cochineal dye is one of the most expensive of all the processes of dying

When the bright flame colour is wanted, a little yellow fustic is added to the first bath, or else some turmeric is added to the second with the cochineal. The ease with which the alkaline and earthy salts counteract the yellow part of these colours, which causes the scarlet cloth to be changed more or less to a rose or crimson by fulling; if the scarlet when finished has too much of an orange tint, this may be corrected by afterwards boiling the cloth in hard water, or one that contains an earthy salt. After the full scarlet has been given to the cloth, the liquor still retains part of the cochineal, with a large portion of the mordant, and this is used for the lighter dyes, or, with the addition of fustic, madder, and other ingredients, is employed for a vast variety of mixed or degraded reds.

To dye a pound of wool Scarlet.

Boil it in a tin vessel, with something less than a quart of water, three drachms of tartar, and one ounce and a half of cochineal; when the ebullition begins, add one ounce and a half of tin, say solution of tin, boil the whole a quarter of an hour; the vessel is then taken from the fire, and the solution poured into a large cauldron of boiling water, at the instant the cloth is immersed in it.

The Dutch manner of dying Scarlet.

Boil the cloth in water, with alum, tartar, rock salt, nitric acid, and pea flowers, in a pewter kettle; then put into the same kettle, starch, tartar and cochineal, finely powdered, stirring or turning the cloth well about; thus you may, by adding more or less cochineal, raise the colour to what height you please.

To prepare the cloth for dying Scarlet.

First, Take, to one pound of cloth, one part of bran water and two parts of river water; put into it two ounces of alum and one ounce of tartar, when it boils and froths skim it and put in the cloth, turn it therein for one hour, then take it out and rince it.

To dye cloth a common Red.

Take to twenty yards of cloth three pounds of alum, one pound and a half of tartar, and one third of a pound of chalk, put them into a kettle with water, and boil them, take six pounds of good madder, and a wine glass full of vinegar, let them be warmed together, put in the cloth, and turn it round upon the winch, till you observe it red enough, then rinse it out and dry it.

Another Method.

Take four pounds of alum, two pounds of tartar, four ounces of white lead, and half a bushel of wheaten bran, put these ingredients together with the cloth into a kettle, let it boil for an hour and a half and leave it to soak all night; then rinse it, and take for the dye, one pound of good madder, two ounces of Orleans yellow, one ounce and a half of turmeric, and two ounces of nitric acid; boil them, turn the cloth on the winch for three quarters of an hour, and it will be a good red.

To dye Worsted, Stuff or Yarn a Crimson Colour.

Take, to each pound of worsted, two ounces of alum, two ounces of white tartar, two ounces of nitric acid, half an ounce of pewter, quarter of a pound of madder, and a quarter of a pound of logwood, put them together in fair water, boiling the worsted therein for a considerable time; then take it out, and when cool rinse it in clean water; then boil it again, and put to each pound of worsted a quarter of a pound of logwood.

Another.

Take to eight pounds of worsted, six gallons of water, and eight handfuls of wheat bran, let them stand all night to settle, in the morning pour it clear off and filter it; take thereof half the quantity, adding as much clear water to it, boil it up, and put in one pound of alum, and half a pound of tartar, then put in the worsted, and let

it boil for two hours, stirring it up and down all the while it is boiling with a stick Then boil the other half part of the bran water, mixing with it the same quantity of bran water as before; when it boils, put into it four ounces of chochineal, two ounces of finely powdered tartar; stir it well about, and when it has boiled for a little while, put in your stuffs, keep stirring it from one end to the other with a stick, or turn it on a winch till you see the colour is to your mind, then take it out of the kettle, let it cool, and rinse it in fair water.

A Carnation for Woollen.

Take four ounces of ceruse, three ounces and a half of arsenic, one pound of burnt tartar, one pound of alum, boil your stuffs with these ingredients for two hours, then take them out and hang them up; the next morning make a dye of two pounds of good madder, two ounces of turmeric, and three ounces of acqua fortis.

To dye a Carnation on Silk or Cotton.

Take three pounds of alum, three ounces of arsenic, and four ounces of ceruse, boil the silk or cotton therein for an hour, then take it out and rinse it in fair water; after which make a ley of eight pounds of madder, and two ounces of muriate of ammonia, soak the silk or cotton therein all night; boil it a little in fair water, and put into it one ounce of potash, then pour in some of the ley and every time you pour the colour will grow deeper, so that you may bring it to what degree you please.

Another.

Take to one pound of silk, cotton, or yarn, one ounce of tartar, and half an ounce of white starch, boil them together in fair water, then put in one quarter of an ounce of cochineal, a quarter of an ounce of starch, and a quarter of an ounce of pewter, dissolved in half an ounce of aqua fortis, and mixed with fair water; when the water with the starch and tartar has boiled for some time, supply it with the cochineal and the above aquafortis,

put in the silk or whatever you have a mind to dye and you will have it of a fine colour.

Method of Dying Broad Cloth a Carnation Colour.

Take the liquor of wheat bran, three pounds of alum, tartar two ounces; boil them, and then immerse in it twenty yards of broad cloth; after it has boiled three hours, cool and wash it; take fresh clear bran liquor in sufficient quantity, and five pounds of madder; boil as usual.

To make a Curious Red Water, for Silks, Stuffs, &c.

Take two quarts of fair water, four ounces of gum-arabic, one pound of woad and set them over the fire till half is boiled away; then take it off the fire and put in half an ounce of Spanish green, and about thirty grains of cochineal, and put it by for use.

Turkey Red.

Boil the cotton for three hours in pearl ash and fish oil, about an ounce of each to a pound of cotton, and water enough to cover it; wash it, and dry it, immerse it for ten days in fish oil, squeeze or rinse it well, and hang it up to dry, run it through a hot solution of alum, in the proportion of alum one part, water forty parts by weight; then run it through a mixture of cow manure and hot water, again through the alum water, then through a decoction of galls, or sumach, an ounce of galls to the pound of cotton; then through a dilute solution of glue; alum it again after washing it; madder it with half a pound of madder to the pound of cotton; alum it again, and madder it again, with from a quarter to half a pound of madder more to the pound of cotton; brighten it by boiling it for half an hour in a weak solution of white soap.

The foregoing colour may be imitated thus: Boil the cotton in pearl ash and oil as above directed; wash it and

dry it; alum it as before, and then run it through the cow manure liquor; wash it; take the common printer's mordant, of alum one pound, sugar of lead two pounds; water one gallon, dissolve, add another gallon of water; immerse the cotton for a day in this hot solution; then madder it with three quarters of a pound of madder, and one ounce of galls to the pound of cotton—this may be relied on.

General observations for dying Cloth of a Red or Scarlet colour.

1st. The cloth must be well soaked in a ley made of alum and tartar; this is commonly done with two parts of alum and one part of tartar. 2d. For strengthening the red colour, prepare a water of bran or starch; bran water is thus prepared: take five or six quarts of wheat bran, boil it over a slow fire in rain water for a quarter of an hour, and then put it, with some cold water, into a small vessel, mixing it up with a handful of leaven; *the sourer it is made the better.* This causes the water to be soft, and the cloth to become mellow; it is commonly used in the first boiling, and mixed with the alum water. 3d. Agaric is an ingredient used in dying of reds, but few dyers can give any reason for its virtue, as it is of a dry and spongy nature. It may reasonably be supposed, that it corrects the greasiness that may happen to be in the dye. 4th. Arsenic is a very dangerous ingredient; nitric or muriatic acid, may supply its place as well. 5th. Scarlet is a variety of crimson colour; the nitric acid is the chief ingredient in the change; this may be tried in a wine glass, wherein a deep crimson colour is put; by adding drops of nitric acid to it, it will change into a scarlet. 6th Observe that you always take one part of tartar to two parts of alum; most dyers prefer the white to the red tartar; but, however, in crimson colours, and others that turn upon the brown, the red tartar is chosen by many as preferable to the white.

Of Dying Blue.

Blue may be dyed with woad alone, which would give a permanent but not a deep blue; but if indigo be mixed

with it, a very rich colour will be obtained. The following is a method:—

Preparation of the Blue Vat.—Into a vat, about seven feet deep and five and a half broad, are to be thrown about 400 lbs. of woad, broken in pieces; thirty pounds of weld are boiled in a copper about three hours, in a sufficient quantity to fill the vat; when this decoction is made, twenty pounds of madder and some bran are to be added, and it is then to be boiled half an hour longer. This bath is to be cooled with 20 buckets of water; and after it is settled the weld is to be taken out, and it is to be poured into the vat, and for a quarter of an hour longer is to be stirred with a rake. The vat is then covered up very hot and left to stand six hours, when it is raked again for half an hour, and this operation is repeated every three hours.

When blue veins appear on the surface of the vat, eight or nine pounds of quick lime are thrown in; at the same time, or immediately after, the indigo is put into the vat, being first ground fine in a mill with the least possible quantity of water. When diluted to the consistence of a pap, it is drawn off at the lower part of the mill, and is thrown into the vat. The quantity of indigo depends on the shade of colour required. A vat which contains no woad is called an indigo vat. The vessel used for this preparation is of copper, into which is poured water in the proportion of 120 gallons to 6 pounds of potash, 12 ounces of madder, and 6 pounds of bran have been boiled; six pounds of indigo, ground in water, are then put in, and after carefully raking it the vat is covered and a slow fire kept round it; twelve hours after it is filled, it is to be raked a second time, which is to be repeated at similar intervals of time, till it comes to a blue, which will generally happen in forty-eight hours. If the bath be well managed it will be of a fine green covered with coppery scales, and a fine blue scum. In this vat the indigo is rendered soluble in the water by the alkali instead of the lime.

A second method for preparing a Blue Vat.— Heat soft water in a kettle; put to it four or five handfuls of wheat bran, together with four pounds of pot ash; when that is dissolved, boil it for an hour, and add four pounds

of madder; boil it for an hour longer; then pour the water into the vat; do not fill it by the height of a foot; then cover the vat; then set it with indigo and woad, of each six pounds, and two pounds of pot ash: put this into a small kettle in warm water; set it on a slow fire and let it boil gently for half an hour, stirring it all the while; then pour that into the other liquors already in the vat. To set a vat with indigo only, you must boil the first ley with pot ash, four or five handfuls of bran, and a half or three quarters of a pound of madder; this boil a quarter of an hour, and when settled it will be fit for use; then grind the indigo in a bowl, with an iron smooth ball, very fine, pouring on some of the ley and mixing it together; when settled pour the clear into the blue vat, and on the sediment of the indigo pour again some of the ley. This operation should be repeated till you see all the colouring matter is extracted from it. It is to be observed that the madder must be but sparingly used, for it only alters the colour and makes it of a violet blue, which, if you design to have, cochineal is fitter for. The mixed colours in blue are the following: Dark blue, deep blue, high blue, sky blue, pale blue, dead blue, and whitish blue. By mixing of blue and crimson, purple, columbine, amaranth, and violet colours are produced, and from those mixtures may also be drawn the pearl, silver-gridlin, &c. colours. From a middling blue and crimson are produced the following colours, viz. the pansy, brown grey, and deep brown. Care must be taken that in setting the blue vat you do not overboil the ley, by which the colour becomes muddy and changeable; be also sparing of the pot ash, for too much gives the blue a greenish and false hue.

Directions for setting another Blue Vat, with observations on the management of both Silk and Worsted.— Take half a bushel of clean beech ashes, well sifted: of this make a ley with three pails of river or rain water; pour it into a tub, and put in two handfuls of wheat bran, two ounces of madder, two oun ces of white tartar finely powdered, one pound of pot ash , half a pound of indigo, pounded fine; stir it well toge her once every twelve hours, for fourteen days succe ssively; when the liquid

appears green on the fingers it is fit for dying; stir it every morning, and when done cover it. When you are going to dye silk, first wash the silk in fresh ley, wring it out, and dip it into the vat. You may dye it of what shade you please by holding it longer or shorter in the dye. When the colour is to your mind, wring the silk; and having another tub ready at hand with clear ley, rinse the silk therein; then wash and beat it in fair water and hang it up to dry. When the vat is wasted, fill it with the ley; but if it grows too weak, supply it with half a pound of pot ash, half a pound of madder, one handful of wheat bran, and half a handful of white tartar: let it stand for eight days, stirring it every twelve hours, and it will be fit for use.

Another method for Woollen.

Fill a kettle with water, boil it, and put pot ash into it; after it has boiled with that a little, put in two or three handfuls of bran; let it boil for a quarter of an hour, and then cover it, take it off the fire, and let it settle, pound indigo as fine as flour; then pour the above ley to it, stir and let it settle, and pour the clear ley into the vat; then pour more ley to the sediment, stir it, and when settled pour that into the vat also —repeat this till the indigo is wasted. Or, take a quarter of a pound of indigo, half a pound of pot ash, a quarter of a pound of madder, and three handfuls of bran: let them boil for half an hour, and then settle; with this ley grind the indigo in a copper bowl; put this in an old vat of indigo, or on a new one of woad, and it will make it fit for use in twenty-four hours.

To dye Saxon Blue.

Take four parts of sulphuric acid, and pour on one part of indigo, in fine powder: let the mixture be stirred for some time; and having stood twenty-four hours, one part of dry powder is added; the whole is to be again well stirred; and having stood a day and night, more or less water is added gradually. To dye cloth with it, it must be prepared with alum and tartar. A greater or

less proportion of indigo is put into the bath, according as the shade required is deep or light. For deep shades the stuff must be passed several times through the bath. Lighter shades may be dyed after the deep ones, but they have more lustre when dyed in a fresh bath: There should be a false bottom ready to put into the vat over the settlings: this bottom should be pierced with a number of holes, so as the essential parts contained in the settlings may intermix with the dye without disturbing them; or if the false bottom is not used, the cloth should be hung on a winch, or manipulated in such a manner as neither to disturb or touch the settlings, and this rule must be observed in all cases. When the vat is thus prepared, the stuff previously wrung out of warm water, is put into it, and kept a longer or a shorter time, according to the degree of strength that is to be imparted to the colour. When taken out, its green colour, which it has imbibed in the bath, is instantly changed by the action of the atmosphere.

In dying Saxon blue, a mordant is used of three ounces and three quarters of alum, and two ounces and a quarter of cream of tartar to one pound and a quarter of cloth. After being boiled in this composition an hour, the stuff is left in about twenty-four hours longer. The colour bath is prepared by pouring into boiling water an ounce, or rather less, of the solution of indigo in sulphuric acid, to one pound and a quarter of cloth, which is boiled in it twenty or thirty minutes, and after being taken out, is carefully washed.

Receipt to dye 8 lbs. of Deep Blue in Linen or Cotton.

Take 4 ounces of indigo and grind it fine, 2 ounces of madder, 8 ounces of copperas, 8 ounces of pot ash, 4 ounces of lime, and 1 ounce of alum: mix all together with five gallons of soft water. The dye is fit for use the second day. Scald cotton before you colour it. Stir the dye morning and evening. This quantity is for 8 lbs. of deep blue in linen or cotton.

Another Blue.

A vat with caustic alkali can be made thus: To a pound of indigo well washed, add one and a half pounds of pearl ashes, and two pounds of lime, fresh slacked, and about two gallons of water; boil them for two hours, then add about twenty gallons of hot water, and a quarter of a pound of green vitriol, *vitriol of iron*, and as much red arsenic; stir it frequently; when a green froth is risen it is ready. Or grind a pound of indigo in urine, fresh or stale, add to it about forty gallons of urine, stir it with a rake till the green scum rises, and the indigo appears dissolved. Dip the cloth in this, till the vat is exhausted.

To make a Curious Blue Water for Silks, Stuffs, or Woollen.

Take three parts of soap boiler's ashes, and one part of unslacked lime, make a ley of them and suffer them to settle, then decant off the thinner part and add one pound of bolemin, stir them well over a gentle fire, adding a pound of woad and half a pound of indigo, dipping whatever is to be coloured into it, when very hot till it takes the colour.

How to dye Wool, in the Grease, a Permanent Blue.

Take four ounces of indigo, reduced to powder and passed through a silk sieve; for every ounce of indigo, take twelve pounds of wool in the grease, and put the whole into a copper large enough to contain all the wool intended to be dyed. Begin by covering the bottom of the copper, with a thin layer of powdered indigo, on this put a layer of wool, on this a second layer of indigo, and so on alternately to the boiler is full, taking care that the first and last layers be of indigo, and the wool be well separated in layers of equal quantity. A ley of wood ashes or pot ash should be previously prepared, strong enough to bear an egg, and in sufficient quantity to fill the boiler, and entirely to cover the materials.—

Before the ley is poured on it should be warmed, but not so as to prevent the manipulation. As soon as the boiler is filled, the wool is to be pressed down equally all over, and worked with the hand, so that it may imbibe the liquid uniformly; a gentle heat must be kept up till the next day, with small coals, or hot ashes, thrown under the boiler. Attention must be paid to raise the degree of heat, before and during the manipulation, and to work the wool every day for a week, for the more labor bestowed on the manipulation, the greater uniformity and intensity of colour will it acquire. As soon as the requisite colour is obtained, the wool is to be dried, and this completes the operation. A light blue may be had, by diminishing the quantity of indigo. The liquor remaining after dying, may be again used to produce light blues.—This is the most simple and economical process that can be used for dying wool of a blue colour.

To dye Cotton Yarn a Deep Blue.

Take one pound of logwood chipped fine or pounded, boil it in a sufficient quantity of water till the whole colouring matter is extraced, then take about half a gallon of this liquor and dissolve it in an ounce of verdigris, and about the like quantity of alum, boil the yarn in the mean time, in the logwood water, for one hour, stirring it well and keeping it loose. Take out the yarn and mix the half gallon containing the verdigris and alum with the other, then put the yarn into the mixture and boil it four hours, stirring it and keeping it loose all the time, and taking it out once every hour to give it air, after which dry it, then boil it in soap and water and it is done. The above preparation will dye six pounds of cotton yarn, a deep blue, after which put as much yarn into the same liquor and boil it three hours, stirring it as before, and it will give a good pale blue; or if you want an elegant green, boil hickory bark in the liquor and it will produce it.

Yellow

Is usually imparted to woollen substances by a decoction of woad, but as this plant yields its colouring

principle with difficulty, alkalies are employed to assist in its extraction. Alkalies are used chiefly for this purpose in dying of linen or cotton, and their place must be supplied by salt, sal ammoniac, and alum; when woad is to be applied to animal substances which are dissolved in alkalies, lime is sometimes used, to heighten the colours. A good yellow of different tints may be procured by boiling woad with marine salt, lime or alum; the salt produces the deepest shade; alum renders the colour brighter; ammonia imparts a greenish hue to the bath; tartar gives a very pale shade; and copperas changes it to a brown.

To dye Silk Yellow.

Silks intended for a yellow colour, are boiled in the proportion of about one pound of soap to about five pounds of silk; they are afterwards washed, alumed, and exposed on rods. The yellow bath is prepared by boiling two pounds and a quarter of woad to the pound of silk about a quarter of an hour. This bath is strained through a sieve, and let cool till the hand can be kept in it, before the silk is immersed in the vat. A golden hue may be imparted to silk by means of annatto.

To dye Silk a Poppy Colour.

The most beautiful red imparted to silk is that termed poppy. This colour is prepared by precipitating on stuff, bastard saffron, [*samfl ure*] held in a solution of pot ash, with this view, when the silk is washed and put on rods, citric [*saffron*] juice is poured into the bath till it acquires a cherry colour, it is then well stirred, and the silk repeatedly let down into it till it has acquired a sufficient colour. To produce a full poppy colour the silk is wrung on coming out of the first bath, which it exhausts, and is then put into the second. Five or six baths are requisite to impart to it a flame colour. The poppy colour is heightened by putting the silk through tepid water acidulated with lemon juice. Annatto, three or four shades paler than aurora, is requisite for silks before exposing them to the colouring prin-

ciple of bastard saffron.—The poppy colour communicated by this last dye may be imitated by Brazil wood.

To dye Silk a Straw Colour Yellow.

Take silk, alum and rinse it as before directed; then boil to each pound of silk one pound of fustic, and let them stand for a quarter of an hour; put into a tub large enough for the quantity of silk, with a sufficient quantity of ley and fair water; in this rinse the silk; fill the kettle again with water, and let it boil for one hour, and having wrung the silk out of the first liquor, and hung it on sticks, prepare a stronger ley than the first—in this dip your silk till the colour desired is obtained.

Another Method.

Put into a clean kettle, to each pound of silk, two pounds of fustic; let it boil for an hour, then put in six ounces of galls; let them boil together half an hour longer, and having wrung the silk out of the first liquor and hung it on sticks, prepare a stronger ley than the first—in this dip the silk till the desired colour is obtained.

Another Method.

Put into a clean kettle, to each pound of silk, two pounds of fustic; let it boil for an hour; then put in six ounces of galls; let them boil together half an hour longer. The silk being alumed and rinsed, is turned about in this colour; then take it out of the kettle and wring it; dip it in pot ash ley, and wring it out again; then put it into the kettle; let it soak a whole night, and in the morning rinse it; then beat it out and hang it up to dry.

Beautiful newly discovered Golden Yellow for Silks, Cottons, &c.

This fine, lively, yellow dye, has been discovered by Mon. Lastyre. It is obtained from the shaggy spunk, the *boletus hirsutus*, a species of mushroom or fungus,

growing chiefly on apple or walnut trees. This vegetable substance is replete with colouring matter, which must be expressed by pounding in a mortar; after which the liquor thus acquired is boiled about a quarter of an hour. Six pints of water may be well tinged for dying by a single ounce of the expressed fluid. This being strained, the silk, cotton, &c. intended to be dyed must be immersed and boiled in it for fifteen or twenty minutes, when fine silk, in particular, if it be afterwards passed through soft soap water, will appear of a bright golden yellow hue, equal in lustre to silks imported from China.

Chinese Yellow Dye or Stain for Silk Stuffs and Paper.

Roast over a clear and gentle fire, in a very clean copper pan, half a pound of the accasia, or, *(as it is called in America,)* the locust flowers, before they are full blown, continually stirring them with a brisk motion, and when they begin to turn yellow, pour over them a little water, and let it boil till it becomes of some consistence, and has also acquired a deeper colour; then straining the liquid through a piece of coarse silk, add to it half an ounce of finely powdered alum, and an ounce of finely calcined and powdered oyster shells; mix the whole well together and keep it for use.

Another Vegetable Yellow Dye.

Cut off the yellow flowers on potatoe tops; bruise them and press out the juice. Linen or woollen soaked in this liquor forty-eight hours, takes a fine, solid, and permanent yellow colour. If the cloth be afterwards plunged into a blue dye, it then acquires a beautiful permanent green.

To dye Yarn a Yellow Colour.

In a kettle of strong ley put a bundle of woad and let it boil; then pour off the ley, and take to one pound and a half of yarn half an ounce of verdigris, and half an ounce of alum, boiled with ley; stir it well together,

and pour it in, and mix it with the woad ley; in this soak the yarn over night, and it will be a very good yellow.

A fine Brimstone Yellow for Worsted.

Take three pounds of alum, one pound of tartar, and three ounces of salt; boil the cloth with these materials for one hour, pour off the water, and poor fresh into the kettle, make a strong bath of weld, let it boil, then turn the cloth quickly upon the winch twice or thrice, and it will have a fine brimstone colour.

A Lemon Colour.

Take three pounds of alum, three ounces of ceruse, and three ounces of arsenic: with these ingredients boil the cloth for an hour and a half, pour off the water, and make a ley of sixteen pounds of yellow flowers, and three ounces of turmeric; then draw or winch your cloth through quickly, and it will be of a fine lemon colour.

To dye an Olive Colour.

To dye this colour, observe the directions for dying brimstone colour, then make a ley of gall nuts and vitriol, but not too strong, draw your stuff quickly through, three or four times, according as you would have it either deeper or lighter.

To dye a Golden Colour.

Having first dyed the silk, linen, woollen, or cotton, of a yellow colour, take to each pound of the commodity, one ounce of yellow chips and one drachm of pot ash; boil for half an hour, then put in your silk, and turn it till the colour required is produced. Weld is considered by most dyers as the yellow which unites beauty with durability in the highest degree.

To dye Wool or Woollen Cloth Yellow.

The wool is first cleansed and then passed through a bath of about four parts alum and one of tartar, to every sixteen parts of wool. It is then dyed in the weld bath, for which from three to four parts of weld are used to one of wool. A golden yellow, with more or less orange, is given by a weak madder after the welding. Silk is dyed of a golden yellow generally with weld alone. The stuff is first boiled in soap water, alumed and washed, then passed twice through a weld bath, in which, the second time, some alkali is dissolved, which gives a rich golden hue to the natural yellow of the plant. A small quantity of annatto still further deepens the colour. The solutions of tin apply well to silk, and with weld give it a bright clear yellow.

To dye Cotton Yellow.

It is first cleansed with wood ashes and water, rinsed, alumed, and dried, and then passed through a yellow bath, in which the weld at least equals the cotton in weight. When the colour is sufficiently taken, the cotton is thrown into a bath of sulphate of copper and water, and kept there for an hour, after which it is boiled in a solution of white soap, and finally washed and dried. If a deeper jonquil yellow be required, the aluming is omitted, and in stead, a little verdigris is added to the weld bath, and the cotton finished in soda. In giving the lively, greenish, lemon yellow, weld is preferred to all other materials. Wool may be dyed a fast yellow colour with quercitron, *black oak bark*, by being first cleansed, and then boiled for an hour, with one-sixth part of its weight of alum in water; then, without rinsing, transferred into the vessel containing a decoction of as much quercitron bark as there was used of alum, and turned through the boiling liquor over the winch till the colour appears to have taken. Chalk or alkali is of great service in yellow dying, whether with weld, quercitron, or any other colour when the mordant is alum, as this addition helps to bring out

and heighten the dye. The salts of tin, being powerful mordants for almost every colouring matter, may be used with advantage in dying yellow of the finest colours.

To dye 100 lbs. of Cloth the finest Orange Yellow.

Take ten pounds of quercitron bark, tie it up in a bag, put it into the boiler, and when boiled a few minutes, put in ten pounds of the nitro muriate of tin, stir and mix both well together; then the cloth, being previously scoured and wet, is passed briskly through the liquor over a winch for about a quarter of an hour.

Green.

To dye woollen green, either a blue or yellow dye may be first given to it, but the first is generally used because the yellow dye of the stuff would injure the blue bath. The intensity of the blue must ever be proportioned to the shade of green required. When the blue dye is given, the yellow is given by some of the processes already described. The cloth having the proper ground, is washed in the fulling mills and boiled as for the common process of welding; but when the shade is to be light, the proportion of salts should be less. In this case, the quantity of weld used should also be less; but for all other shades it should be greater than for dying simple yellow.

Saxon Greens

Are obtained from the sulphate of indigo. From six to eight pounds of quercitron, *black oak bark*, enclosed in a bag, should be put into the bath for every 100 lbs. of cloth, with only a small proportion of water. Just as it begins to grow warm, when the water boils, six pounds of murio sulphate of tin should be put in, and in a few minutes after about four pounds of alum; these having boiled five or six minutes, cold water should be added and the fire diminished, so as to bring down the

heat of the liquor nearly to what the hand can bear; after this as much sulphate of indigo is to be added as will suffice to produce the shade required, taking care to mix it well with the bath. The cloth having been previously scoured and moistened, should then be expeditiously put into the liquor and turned very briskly through it for a quarter of an hour, that the colour may apply itself evenly in every part. By this method beautiful greens may be dyed in half an hour.

A fine Green for dying Silk.

Take to one pound of silk, a quarter of a pound of alum and two ounces of white tartar; put them together in hot water to dissolve; then put in your silk and let it soak all night; take it out the next morning and hang it up to dry; then take one pound of fustic and boil it in four gallons of water for an hour; take out the fustic and put into the kettle half an ounce of finely powdered verdigris; stir it about for a quarter of an hour, draw it off into a tub and let it cool; then put into that colour an ounce of pot ash; stir it together with a stick, dip the silk therein till you think it yellow enough; rinse it in fair water and hang it up to dry; then dip it in the blue vat till you think it enough; rinse it again and beat it over the pin and hang it up to dry. Thus you may change the shades of green by dipping either more or less in the blue or yellow. For the green, take, to one pound of silk, three ounces of verdigris in fine powder, infuse it in a pint of wine vinegar for a night; then put it on the fire; when hot, stir it with a stick and keep it from boiling; in this put the silk two or three hours; or if it is to be of a light colour, let it soak only half an hour; then take scalding hot water, and in a trough, with soap, beat and work up a clear lather; in this rinse your silk; then hang it up to dry; rinse it again in river water; beat it well, and when it is well cleaned and dried, dress it.

To dye Linen of a Green Colour.

Soak your linen over night in strong alum water; then take it out and dry it; take woad, boil it for an hour;

take out the woad and put in one ounce of powdered verdigris, according to the quantity you have to dye; stir it together briskly with the linen; then put in a piece of pot ash, the size of a hen's egg, and the linen will be of a fine yellow colour, which, when dried a little and put into a blue vat, will turn green. Cotton and linen are, in another process, scoured in the usual way, and then first dyed blue; after being cleaned they are dipped in the weld bath to produce a green colour. As it is difficult to give cotton velvet an uniform colour in the blue vat, it is first dyed yellow with turmeric, and the process completed by giving it a green by sulphate of indigo.

The different shades of olive, &c. are given to cotton thread, after it has received a blue ground by galling it, dipping it in a weaker or stronger bath of iron liquor, then in the weld bath, and afterwards in the bath with sulphate of copper; the colour is lastly brightened with soap. Yellow colours are rendered more intense by means of alkalies, sulphate of lime and ammoniacal salts; but they become fainter by means of acids and solutions of tin and alum.

To dye a Brown Red Colour either on Silk or Worsted.

First, after the silk or worsted is prepared in the manner directed for dying of red colours, boil it in madder, then slacken the fire, and add to the madder liquor prepared as will be shewn for black, then stir the fire, and when the dye is hot work the commodities that are to be dyed therein till they are dark enough; but the best way to dye this colour is in a blue vat; therefore, choose either lighter or darker, according as you would have the cloth lighter or darker; then alum and rinse your silk or cloth in fair water; then work it in the kettle with madder till it is of the desired colour.

Brown Dye.

The rinds and roots of walnuts, saunders wood, elder bark, sumac, and even soot, &c. are used in this dye,

The rinds of walnuts are the husks which cover the nuts. Of all ingredients for a brown dye, this is considered the best, and next to the rind ranks the roots of the walnut tree. The superiority of the walnut rind dye compared with the others, consists in its shades being finer, the durability of its colour, and its property of softening the wool and rendering it of a better quality, as well as easier worked. To make use of this rind a copper is half filled with soft water; and when it begins to grow warm the rind is added in a quantity suited to the goods and their intended depth of colour; the stuffs in the mean time having been dipped in warm water, are put into the copper as soon as the ingredients have boiled about a quarter of an hour, where they are worked, till they have acquired the colour intended, being aired as usual to cool them, they are dried and dressed. When the shades are required to be very exactly matched, and the goods are spun wool, a small quantity of the rind should be first put in, and the lighter made; then more rind being added, the deepest. But with stuffs in general the deepest are commonly made first; as the liquor diminishes, the lightest are dipped. For dying with the root, a copper is three quarters filled with river water, and the requisite quantity of roots cut into small pieces and boiled moderately, care always being had to leave in it some dying substance.

Of Blacks.

The black commonly given to all kinds of stuff is that which is produced by some vegetable astringent, particularly galls, with the salts of iron; but many circumstances must be attended to in order to produce a full and good colour. Wool takes this kind of black with much more ease than linen or cotton. For every fifty pounds of cloth take eight pounds of logwood and as much galls, both bruised or powdered; tie them loosely in a bag, and boil in a moderate sized copper for about twelve hours, with sufficient quantity of water; put one third of this decoction, with a pound of verdigris, into another copper, and soak the cloth in it for

two hours, keeping the liquor scalding hot, but not boiling. Take out the cloth, add to the same copper another third of the same decoction, with four pounds of vitriol or sulphate of iron, and bring it again to a scalding heat, and soak the cloth in it for an hour, stirring it well all the time; then take out the cloth, and add the remaining third of the decoction, with eight or ten pounds of sumac; boil the whole, lower the heat with a little cold water, add a pound more of vitriol, and return the cloth for an hour longer. The cloth is then washed and aired, and returned to the bath again for an hour; after which it is well washed in running water and fulled. It is lastly passed through a yellow bath of weld for a short time to give a higher gloss and softness to the black.

To dye Woollen Stuffs a Black Colour.

Fine cloths and stuffs as will bear the price, must be first dyed a deep blue, in a fresh vat of pure indigo; after which boil the stuffs in alum and tartar; then dye in madder, and lastly with galls of Aleppo, sulphate of iron, and sumac, dye it black. To prevent the colour soiling when the cloths are made up, they must, before they are sent to the dye house, be well scoured in a scouring mill. Middling stuffs, after they have been prepared by scouring and drawn through a blue vat, are dyed black with gall nuts and vitriol. For ordinary wool or woollen stuffs, take of walnut tree branches and shells a sufficient quantity, with this boil your stuff to a brown colour, then draw it through the black dye, made with bark of elder, iron or copper filings and Indian woad.

To dye Linen a Black Colour.

Take the filings of iron, wash them, and add to them the bark of elder tree, boil them up together, and dip the linen therein.

To dye Woollen of a good Black.

First take two pounds of gall nuts, two pounds of the bark of elder tree, one pound and a half of yellow chips; boil them for three hours, then put in the stuffs, turn them well on the winch, and when you perceive the goods black enough, take them out and cool them; take an ounce and a half of muriate of ammonia; with this boil the stuff for one hour, turning it on the winch all the while; take it out and let it cool; take two pounds and a half of vitriol, a quarter of a pound of sumac, boil the stuff therein for an hour, then cool and rinse it, and it will be a good black.

Another Black Colour for Woollen.

For the first boiling take two pounds of gall nuts, half a pound of Brazil wood, two pounds and a half of madder; boil the cloth in these ingredients for three hours, then take it out to cool. For the second boiling take one ounce and a half of sal ammoniac, and for the third two ounces of vitriol, three quarters of a pound of Brazil wood, and a quarter of a pound of tallow.

To dye Silk a good Black.

In a kettle containing six pails of water, put two pounds of beaten gall nuts, four pounds of sumac, a quarter of a pound of madder, half a pound of antimony finely powdered, four ox galls, four ounces of gum tragacanth dissolved in fair water, fine beaten elder bark two ounces, and one ounce and a half of iron file dust: put these ingredients into the water and let them boil for two hours, then fill it up with a pail full of barley water and let it boil for an hour longer, put in the silk and let it boil for half an hour slowly, then take it out and rinse it in a tub with clean water, and pour that again into the kettle; the silk being rinsed in clear running water, is then hung up, and when dry put into the copper again, boil it slowly for half an hour as before, then rinse it in a tub, and again in rain water; when dry take good lye, put into it two ounces of pot ash, and when they are dissolved rinse the silk therein quickly, then in

running water; this done, hang it to dry, and order it as you would other coloured silks. This colour will also dye all sorts of manufactured woollen stuffs. To give the black silk a finer gloss, you must for each pound put in one ounce of isinglass, dissolved in water, for the last dipping.

On the modes of procuring Colours for dying in the island of Scios.

The women in Scios procure a golden colour from the branches of the oriental nettle tree and from the leaves of the henna or Egyptian privet; a bright yellow from the flowers of the broom and the stems of the silvery leafed daphne; the roots of the apple tree yield them a pale rose colour; the wood of the quince tree furnishes them a very bright flesh colour, and they extract from the branches of the peach tree a bright green, and from its leaves a deep. In order to obtain the several colours they cut the ligninous substances into small pieces and steep them in water two days, boil them the third day till the liquor is reduced one half, they then strain it through a cloth, and add a little alum thereto, and set it again over the fire; as soon as the liquor boils they steep their silks in it for a longer or shorter time, according as they want a deeper or paler colour The red peelings of the onions afford them a tolerably bright orange colour—in order to obtain it they put them to soak four or five days, then boil them with a little alum. When they wish to have a beautiful red they add a spoonful of cochineal or of kermes.

Iron Liquid.

In any vegetable acid dissolve an oxyd of iron, and to the solution add iron in a metallic state, which is thereby dissolved and forms an iron liquor—for example, take Spanish brown, Venetian red, or any other vegetable acid, brought to a boiling heat or nearly so, and when the solution has taken place, pour it upon pieces or lumps of iron, let them remain together for twenty-

four or thirty-six hours, then boil the liquor a second time with the same or fresh pieces of iron, and when cold pour it off for use. By this process the iron liquor, which by the common method now in use requires as much as seven weeks to bring it to perfection, may be completed in two or three days.

To dye Bristles a Curious Red for Brushes.

Take one ounce of Brazil wood in powder, half an ounce of alum, a quarter of an ounce of vermillion and a pint of vinegar, boil them up to a moderate thickness, and dip the bristles in when very hot, suffering them to continue for some time in the liquor, and they will be of a curious red colour.

To dye Bristles or Feathers a curious Green.

Take one ounce of verdigris, one ounce of verditer, and one pint of gum water; mix them well together, and dip the bristles or feathers therein, they having been first soaked in hot water.

To dye Bristles or Feathers Blue.

Take an ounce of indigo, one ounce of bice, and the size of a hickory nut of alum; put them into gum water, and dip the materials into it hot, hang them up to dry, and clap them well that they may open; and by changing the colours, you may in this manner dye the aforesaid materials of any colour—as for black, use logwood and galls; for purple, lake and indigo; for carnation, vermilion and smalt; for yellow, French berries and saffron, with a little tartar mingled or dissolved in the gum water.

BLEACHING.

To bleach Ornamental Feathers.

FEATHERS can be effectually bleached by simply immersing them for a few hours in pure water acidulated with oil of vitriol, in the proportion of six or eight drops of vitriol to every ounce of water, then dry the feathers in the sun or by the fire The bleaching of plumes may be effected in a very simple manner, without much difficulty, in the following manner: Mix in a bason equal parts of red lead and common salt, or in preference manganese of the shops, to this mixture add about half its weight of oil of vitriol previously diluted with a small quantity of water; take the plume to be whitened, and after wetting it in water, expose it to the fumes or gas arising from the mixture. In half an hour or less time, the feather will become beautifully white. This plan has been repeatedly tried, and, from its simplicity, is recommended to feather-workers. From the nature of the materials, it is obvious that the oil of vitriol disengages the marine acid from the common salt, which then becomes oxygenated from the red lead or manganese. The gas, therefore, disengaged, is the oxymuriatic. By combining with the water on the feather, it forms liquid oxymuriatic acid, and discharges the colour.—Variegated plumes may be cleaned and restored to their former brightness, by gently wiping with a soft sponge dipped in spirits of wine, and after having been gradually dried, by moistening the downy part with a a filtered solution of gum arabic or tragacanth; then cautiously exposing the tops and sides to the heat of a bright fire in order to curl their extremity.

Bleaching Cotton after the Swabian method.

Take two measures of quick lime, and place them in a heap in a corner of a workshop, taking care, that there is no wooden floor on the spot, nor wainscotting to the

wall against which the lime is thrown; cover the lime gradually with ten measures of good ashes, by sifting them equally over it; sprinkle with water lightly between every layer of ashes, and take care to fill up with wet ashes the crevices that are constantly formed by the heat and moisture of the mass. When the lime is slacked and the mass thoroughly cooled, make the ley with cold rain or river water, in which there is little or no admixture of iron; carefully untwist the skeins of cotton, tie them in parcels, and immerse them cold in this caustic alkali, in which leave them for six hours, turning them about from time to time. The ley when exhausted, is generally thrown away as useless, but it might perhaps be better employed in slacking a fresh quantity of lime. After taking the skeins out of the ley, wash them in a running stream.

Method of bleaching Linen by the action of Atmospheric Air.

This method, though tedious, is very convenient for private families, being much cheaper than the method used by manufacturers, who are under the necessity of employing expensive apparatus to carry on their work extensively.

After the linen comes from the loom, it is boiled or steeped in a weak ley, made of wood ashes, or rather of a solution of pot ashes in water, for the purpose of removing the weaver's size or dressing, after which it is dried, and then undergoes the operation of *bucking*.

For this purpose, a ley is prepared by dissolving a quantity of pot ash in soft water, to which some soap is added. This liquor is heated to about 100°, and poured on the pieces of linen in a large tub or other suitable vessel, (but be sure that it be not of iron.) After the cloth is well covered with the ley, and it is a little cooled, it is drawn off and heated a little higher than before, and then again poured on the cloth. This operation is continued for several times, still increasing the heat a little higher, and allowing it to remain a little longer on the cloth for five or six hours.

Then the cloth is left steeping for three or four hours, when it is taken out, well rinsed and taken to the field. Here it is spread upon the grass, and water is sprinkled on it, so as not to let it become entirely dry for some hours. After it has lain half a day, the sprinkling is less frequent, and at night it is left out to the full effect of the air and dews. On the succeeding days it is watered three or four times a day, if the weather be dry, and then it remains in the field till the air seems to have little effect upon it, when it is again brought to the tubs or coppers, and *bucked* again with a ley somewhat stronger than the last, rinsed, and again spread on the field. It is thus alternately *bucked* and *watered* for ten or fifteen times, according to the weather, making the bucking stronger and stronger, till about half bleached, and then weaker and weaker towards the finishing.

It must now undergo the process of scouring or steeping in some acid liquor. That usually employed is formed by a fermentation of bran and water, or sometimes sour whey has been used, and common butter milk; but sulphuric acid (oil of vitriol) diluted with water till quite weak, has been found much preferable to either of them.

If the bran or milk acid be used, the cloth is kept in it five or six days; but it need not be kept in the sulphuric acid and water more than three or four days. The cloth is then rubbed with soap, particularly the selvages. The cloth is then again bucked, rinsed, watered, and exposed to the air, and these processes continued till it has the desired whiteness.

Bleaching by the Oxygenated Muriatic Acid.

This method is now generally practised in the principal manufactures of Europe, especially in Great Britain, Ireland and France.

The process is too complicated, and the apparatus too expensive for the use of private families; but as it is so much more effectual in producing a clear white colour to the linen, as well as economical in regard to time, it is

perhaps proper in this place, to say a few words by way of explaining the process.

This acid is prepared by chymists, and may sometimes be purchased ready prepared for use; but to save the expense of first preparing the acid, the usual practice is to mix with oxyde of manganese, common salt and sulphuric acid diluted with water. The sulphuric acid acts at once upon the salt and the oxyde of manganese, and disengages from them *chlorine* or oxymuriatic acid gas.

At Manchester the usual portions of the ingredients are,

Manganese, - - - -	3 parts,
Salt, - - - - -	8
Sulphuric acid, - - -	6
Water, - - - -	12

In Ireland the following is the usual proportion:

Manganese, - - - -	6 parts,
Salt, - - - - -	6
Sulphuric acid, - - -	5
Water, - - - -	5

In France and Germany:

Manganese, - - -	20 parts,
Salt, - - - - -	64
Sulphuric acid, - - -	44
Water, - - - -	54

And minium or red lead is sometimes substituted for the manganese.

For Cotton take of

Manganese, - - -	30 parts,
Salt, - - - - -	80
Sulphuric acid, - - -	60
Water, - - - -	120

The oxymuriatic gas produced by this mixture is made to pass by means of pipes, or a kind of funnel, into a solution of water and quick lime, which is kept in agitation during this process, to prevent the lime from settling to the bottom of the vessel. The gas is generally distilled off in a retort made of lead, in the form of a gourd, and the operation kept up until no more gas will pass off, which is known by the bubbling noise in the lime water ceasing, the retort, &c. being

very tight to prevent a loss of the gas. This combination is used as a bleaching liquor in which the lime is steeped, and when its virtues become extracted by the cloth, which is known by mixing a little of the liquid with a small quantity of a solution of indigo in water, (which it will discolour while its power remains,) it is removed by a fresh combination of the materials. This liquor attacks powerfully the vegetable matter contained in the cloth and dissolves it. In some places they pass the cloth over rollers and through the liquid in a manner somewhat resembling that practised by fullers in colouring their woollen cloth; in others, they have what are called *dash wheels* and *squeezers*, which work the cloth in the liquid so as to give it the proper effect; while others work it by their hands, frequently stirring it that all parts may receive the benefit of the liquid equally.

It is absolutely necessary that no iron should come in contact with the liquor during any part of the process.

At the great bleach fields in *Ireland*, four leys of pot ash are applied alternately, with four weeks exposure on the grass, two immersions in the above liquor (oxygenated muriate of lime, &c.) a ley of pot ash between the two, and the exposure of a week on the grass between each ley and the immersion.

During summer, two leys and fifteen days exposure are sufficient to prepare cloth for the action of the oxygenated muriate, then three alternate leys, with immersions in the liquor, will be sufficient for complete bleaching; nothing then will be necessary but to wind the cloth through the diluted sulphuric acid.

Mr. Higgins recommends [see "Higgins' Bleaching Liquor," page —,] the steeping of the cloth after the weaver's dressing has been removed by the weak ley of pot ash, for 12 or 14 hours in his *bleaching* liquor, (see page —,) and then washed and dried. This process is to be repeated six times, that is, six alternate immersions in the liquor, and six in the ley, which has been found sufficient to whiten linen; which must then be passed through the weak acid, worked and dried.

For the use of private families, when linen is soiled by perspiration or grease, it will be of great service to

wards rendering it white, to steep it for some time in a clear liquor, made by mixing one quart of quick lime in ten gallons of water, letting the mixture stand 24 hours, and then using the clean water drawn from the lime. After the linen has been steeped in this liquor, it should be washed in the usual manner, but will require much less soap to be used.

To bleach Cotton.

First scour it in a weak alkaline solution, or rather expose it to the steam of weak pot ash ley. It is afterwards put into baskets, and rinsed in running water, or press it down in a weak solution of sulphuric acid, and then wash it in clean water to remove the acid, lest by too long exposure it injures the fibre of the cotton. Cotton will bear the action of acid better than flax, or with less injury. Being washed from the acid, it is then boiled in soap suds, washed and then immersed in oxymuriate of lime. The washing in soap, and steeping in the oxymuriate is repeated till the cotton or stuff is of a pure white, when it is to be scoured and washed in pure water.

The new discovered method of bleaching by the *steam* of an *alkaline* solution is very expeditious & effectual in whitening linen; and though too expensive for an individual family, yet might be used by several families who live near each other, uniting their interests, and employing some skilful person to attend to the process of bleaching their linen.

For this purpose a vessel should be provided large enough to contain the linen to be bleached at one time, with several gallons of water under it, and a considerable space between the liquid and the linen.

In the bottom of the vessel (which should be of copper) is to be put a strong ley, or solution of pot ash or soda in water, (after the carbonic acid has been extracted from the alkali by lime) and the cloth or thread hung in the vessel *over* the solution in folds, or in such a loose manner as to expose its whole surface equally to the steam rising from the boiling solution, and the vessel being covered very tight, and having a *safety-valve*

at the top, is caused to boil, so as to raise the temperature very high, and to be kept so for several hours. By this means the alkaline steam is caused to act powerfully upon the vegetable matter contained in the linen, and to dissolve it entirely, and separate it in a few hours. After this nothing more is necessary than to wash and expose it upon the grass a few days, and it will be of a beautiful clear white colour, after being cleansed in the manner heretofore described. It is said that five or six hours exposure to vapor, raised by heat to a very high degree, has been found sufficient to complete the process of bleaching.

A wash to prevent flies from injuring Pictures or Furniture.

X

Take 3 ounces of lignum quassia and 2 ounces of houselick, finely pulverised, and put them into a closed vessel with water, and boil them *moderately* for an hour; then strain off the liquor for use. If this liquor be frequently brushed over pictures, &c. it will prevent the flies from injuring them.

If you put 1 quart of alcohol in a glass jar or wide mouthed bottle and add 4 ounces of refined camphor pulverised, setting it in a room and leaving it uncovered, the evaporating fumes rising therefrom, will keep flies out of the room.

ART OF PREPARING AND MIXING COLOURS.

IT will now be proper to explain in an easy manner, the methods of preparing the various bodies employed by painters, for producing the difference of light and shade, which may be termed either pigments or fluids, as they are solid or aqueous, and are distinguished in their several kinds, according to the manner of working them, as oil colours, water colours, enamel colours, &c. but their variety are too numerous to be in general use; most painters, therefore, select a set out of them, and become very unjustly prejudiced against those they reject. It is no little impediment to their improvement in the profession, that they are not more extensively acquainted with all the ingredients fit for their purposes.

These colours which become transparent in oil, such as lake, Prussian blue, and brow pink, are frequently used without the admixture of white, or any other opaque pigment, by which means the tint of the ground on which they are laid retains in some degree its force, and the real colour produced in painting is the combined effect of both; this is called glazing, and the pigments endued with the property of becoming transparent in oil are called glazing colours. As colours are obtained from various substances, the means of preparing them are consequently various; some being of a simple nature and requiring only to be purified and reduced to a proper consistence of texture, and others being compounds of different bodies to be formed only by complex processes, it is therefore very difficult to give such general directions for the making every sort of colour as may be intelligible to all, the methods to be pursued as well as the utensils employed being such as belong to different trades.

Where, nevertheless, simple means and the use of such utensils as are generally known may be sufficient to perform what is wanting, it is best to avoid all tech-

nical terms and more complex methods of operation, adopting such a mode of distinction as may be universally intelligible. We now proceed to the nature and preparation of the several colours as they follow in their classes:—

Class 1st.—*Of Red Colours.*

Vermilion is one of the most useful kind of colours in every kind of painting except enamel or on glass, as it is of a moderate price, spends to great advantage, and stands or holds its colour extremely well; it may be prepared in great perfection by the following process:

Take of quick silver 18 pounds, of flour of sulphur 6 pounds, melt the sulphur in an earthen pot and pour in the silver gradually, being also gently warmed, and stir them well together with the small end of a tobacco pipe; but if, from the effervescence on adding the latter quantities of quick silver, they take fire, extinguish it by throwing a wet cloth, *which should be had ready*, over the vessel; when the mass is cold powder it so that the several parts may be well mixed together; but it is not necessary to reduce it, by nicer levigation to an impalpable powder; having then prepared an oblong glass body or sublimer by coating it well with fire, lute over the whole surface of the glass and working a proper rim of the same round it, by which it may be hung in the furnace, and let the powdered mass be put into it so as nearly to fill the part that is within the furnace, a piece of broken tile being laid over the mouth of the glass, sublime the contents with as strong heat as may be used without blowing the fumes of the vermilion out of the mouth of the sublimer. When the sublimation is over, which may be perceived by the abatement of the heat towards the top of the body, discontinue the fire, and after the body is cold take it out of the furnace and break it; collect then together all the parts of the sublimed cake, separating carefully from them any dross that may have been left at the bottom of the body, as also any lighter substance that may have formed in the neck, and appears to be dissimilar to the rest; levigate the more perfect part, and when reduced to fine

powder it will be vermilion fit for use; but on the perfectness of levigation depends in a great degree the brightness and goodness of the vermilion. In order to perform this, it is necessary that two or three mills of different closeness should be employed, and the last should be of steel and set as finely as possible. It is common, perhaps general, for dealers to sophisticate vermilion with red lead; but to detect with certainty the fraud, both with respect to the general fact and the proportion, use the following means: Take a small, but known quantity of vermilion, suspected to be adulterated, and put it into a crucible, having first mixed with it about the same quantity in bulk of charcoal dust; put the crucible into a common fire, having first covered it with a lesser crucible, inverted into it, and give it a heat sufficient to fuse the lead; when the crucible, being taken out of the fire, should be well shaken by striking it against the ground. If the suspected adulteration has taken place, the lead will be found in its metalline state in the bottom of the crucible, and being weighed and compared with the quantity of cinnabar that was put into the crucible, the proportion of the adulteration may be then certainly known; but if no lead be found in the crucible it may be safely inferred that no red lead had been commixt with the vermilion.

Native Cinnabar

Is found naturally formed in the earth, though seldom so pure as to be fit for the uses of painting, at least without being purified by sublimation. The mistaken notion that it would stand better than vermilion because it was of natural production, has made it to be coveted by painters who are curious in colours; it is, however, not worth their while to be solicitous about it, as it never excelled the best vermilion in brightness, and what is generally sold for it is a pigment compounded of quick silver and sulphur.

Red Lead or Minium.

The goodness of red lead may be seen by its brightness, and a mixture of any kind will make it of a dull

appearance; it is on this account not so liable to be sophisticated as white lead or vermilion. It is lead calcined till it acquires a proper degree of colour by exposing it with a large surface to the fire.

Scarlet Ochre

Is an ochreous, earthy, or rather irony substance, and is the basis of green vitriol, separated from the acid of the vitriol by calcination; it is a kind of orange scarlet colour, and rivals any of the native ochres from its certainty of standing and the extreme strength and warmth, either as a ground or in the shade of carnations; it is used as a colour in any kind of painting. The manner of preparing it is as follows:—

Take green vitriol or copperas, any quantity, and being put into a crucible of which it will fill two-thirds, set it on a common fire to boil, *taking care that it do not boil over*, till the matter be nearly dry, when it will be greatly diminished in quantity; fill then the crucible to the same height again and repeat the boiling and replenishing till the crucible be filled with dry matter; take it then from the fire and put it into a wind furnace, or if the quantity be small, it may continue in the same fire, the coals being heaped up round it; let the contents be calcined there till they become of a red colour; when cold, which must be examined by taking a little of the matter out of the middle and suffering it to cool, for so long as it remains hot the red colour will not appear, though it be sufficiently calcined; when duly calcined take the ochre out of the crucible while hot, and put it into water, in which the parts of the broken crucible may be soaked likewise, to obtain more easily what shall adhere to them, and stir the ochre well about in the water, that all the remaining vitriol may be melted out of it; let it then settle, and when the water appears clear, pour it off, and add a fresh quantity, taking out all the broken pieces of the crucible and proceed as before, repeating several times this treatment with fresh quantities of water; then purify the ochre from any remaining foulness by washing over, and having brought it to a proper state of dryness, by draining it off by a

filter, in which the paper must be covered with a linen cloth, lay it to dry on boards.

Common Indian Red

Is substituted in place of the real kind brought from the East Indies, serving equally well for common purposes, giving a tint verging to scarlet, varying from the true Indian red, which is greatly inclined to the purple, and on account of its warm, though not bright colour, it is much used, as well in finer as coarser paintings in oil; it is afforded cheap, and may be thus managed: Take of the caput mortuum, or ochre, left in the iron pots after the distillation of aqua fortis from nitre and vitriol, two parts, and of the caput mortuum or colcother left in the long necks after the distillation of oil of vitriol, one part, breaking the lumps found among them, and put them in water; and having let them stand a day or two, frequently stirring them well about, lade off as much water as can be got clear of them, and add a fresh quantity, repeating the same quantity till all the salts be washed out, and the water comes off nearly insipid; the red powder which remains must then be washed over, and being freed from the water, laid out to dry. When this is designed for nicer purposes, it should be washed over again in basons, the gross manner of lading it out of one tub into another not fitting always completely to such ends.

Venitian Red:

Useful to house painters in imitating mahagony, and is a native ochre inclining to scarlet, and easily prepared by mixing it with the colcother or caput mortuum, taken out of the aqua fortis pots and washed over, it requires no other preparation for use than to be well ground with oil unless when used in miniature painting, when it should be washed over with the utmost care.

Spanish Brown

Resembles the Venitian red very much in colour, but is fouler; it is a native pigment, and is used much

in the same state nature produces it, being dug up in several parts of England, no other preparation is needful than freeing it well from stones and filth, and grinding it well with oil to render it fit for colourmen, in the preparation of cloths for pictures and other coarse work.

Calcino or Burnt Terra di Sienna,

Is originally yellow, but when moderately calcined, becomes an orange red, though not very bright, it is a native ochre, brought hither from Italy in the state in which it is naturally found, it is calcined by putting lumps of it either in a crucible, or naked in a common fire and continuing it there till the colour be changed from yellow to red. It is exceedingly useful in oil painting, and admits of no alteration; it may be distinguished from other ocherous earths by its semi-transparency.

C. Lake.

The best that is commonly sold is made from the colour extracted from scarlet rags, and deposited on the cuttle fish bone, which may be done in the following manner:—Take a pound of the best pearl ashes, and, having dissolved them in two quarts of water, purify them by filtering them through paper, add then to this solution two more quarts of water, and having put in a pound of scarlet shreds procured from the tailor's, *which must be entirely clean*, boil them in a pewter boiler till the shreds appear to have wholly lost their scarlet colour, take them out of the solution and press them well, dipping them after in water and pressing them again that all the fluid they had imbibed may be got from them, in order to be put back to the rest. Take then another pound of the scarlet shreds, and repeat the like treatment of them in the same solution, as also a third and a fourth pound; while this is doing dissolve a pound and a half of cuttle fish bone in a pound of aqua fortis, in a glass receiver, adding more of the bone if it appear to produce any ebullition in the aqua

fortis, and having strained off the solution through flannel, pour it into the other by degrees, observing whether it produce any effervescence on putting in the last quantity, which if it do in any great degree, more of the cuttle fish bone must be dissolved in aqua fortis, and the solution very gradually added till no ebullition appear to be raised by it in the mixture. If this be properly managed, the fluid will soon become clear and colourless, and the tinging substance extracted from the shreds, together with the cuttle fish bone, will subside to the bottom and form a crimson sediment, which is the lake; the water must then be poured off, and two gallons of hard spring water must be put to the lake, and well stirred about to mix them; this being likewise poured off, after the lake has again settled to the bottom, must be replaced by another two gallons, and the same method must be repeated four or five times; but if hard water cannot be procured, or the lake appear too purple, half an ounce of alum should be added to each quantity of water before it is used. When the lake is thus purified or freed from the salts, it must have the water drained from it in a filter covered with a linen cloth, which has been so worn as to have no nap or down remaining on its surface. After the lake has been drained to a proper dryness, it must be dropped on clean boards by means of a proper funnel, through which the drops being suffered to pass, and rest on the board at proper distances, they will become small cones or pyramids, in which form the lake is suffered to dry, and the preparation is then completed.

Rose Pink.

The basis of this pigment is principally chalk, and the tinging substance extracted from Brazil or Campeachy wood. It will not stand with oil or water, and is seldom employed but for the coarse work of house painters or for paper hanging, unless secured from flying with varnish, when, if good, it may be substituted for lake. It is prepared as follows:—

Take Brazil wood six pounds, or three pounds of Brazil and three of Campeachy wood: boil them an hour with three gallons of water, in which a quarter of a pound of alum is dissolved, purify then the fluid by straining through flannel and put back the wood into the boiler with the same quantity of alum and proceed as before, repeating this a third time, mix then the three quantities of tincture together and evaporate them till only two quarts of the fluid remain, which evaporation must be performed first in the pewter boiler, and afterwards in balneo mariae, prepare in the mean time eight pounds of chalk by washing over, a pound of alum being put into the water used for that purpose, which, after the chalk is washed, must be poured off and supplied by a fresh quantity, till the chalk be freed from the salt formed by the alum; after which it must be dried to the consistence of stiff clay; the chalk and tincture, as above prepared, must be then well mixed by grinding, and afterwards laid out to dry where neither sun nor cold air can reach it, though, if it can conveniently be done, a gentle heat may be used.

Red Ochre

Is a native earth brought chiefly from Oxfordshire, and burnt afterwards by those who prepare it in large ovens, till by calcination it becomes red. It is very useful as well in the more delicate as coarser paintings in oil, for it stands infallibly. For nicer purposes it should be washed over.

Class 2d.—*Of Blue Colours.*

Ultramarine is a bright blue colour, of the highest value in every kind of painting, being equally serviceable in all, even in enamel; it has a transparent effect in oil, and in some degree in water, and will stand without the least hazard of flying; by reason of its high price, Prussian blue has been much introduced to the prejudice of painting in general, as the skies of landscapes and many other parts of modern pictures shew the loss of ultramarine, by their changing from a warm or clear

blue, to a faint green or olive tint. The methods have been continually varied by those who have attempted to prepare this pigment. The following is the best of the more modern:—

Take lapis lazuli, and break it into very small pieces, or rather a gross powder; put it into a crucible, and cover it securely to prevent the coals from falling among it; calcine it in a strong heat for an hour if there be any large quantity, or less time in proportion; quench it when taken out of the fire in vinegar, stirring them well together, and suffer it to remain in that state for a day or two; pour off then the vinegar, except what may be necessary for moistening the calcined lapis lazuli in grinding, which operation it must then undergo in a mortar of flint or glass, till reduced to the greatest degree of fineness those means may effect; but if it appear yet too hard to be ground, give it another short calcination and quench it a second time in vinegar. The vinegar must then be washed off from the powder by putting to it several successive quantities of clean water, each of which must be poured off, when the lapis lazuli is well stirred about in them, and is again settled to the bottom. It must then be ground on a porphyry stone with a muller, till it be perfectly impalpable, and then dried, in which state it is duly prepared to mix with the following cement: Take of Burgundy pitch nine ounces, of white resin and Venice turpentine six ounces, of virgin wax one ounce and a half, and of linseed oil one ounce and a quarter, mix them together by melting in a pipkin over the fire, and suffer them to boil till they acquire so stiff a consistence that, being dropt into water while of this boiling heat, they will not spread on the surface thereof, but form a roundish mass or lump. The cement being thus formed, may be poured out of the pipkin in water, and made into cakes or rolls for use. Of this cement take an equal weight with that of the calcined lapis lazuli, and melt it in a glazed earthen pipkin, but not so as to render it too fluid; then add to it the calcined matter by very slow degrees, stirring them together with an ivory spatula, till the whole appear perfectly mixed. Being thus mixed, heat the composition to a degree something

greater, and cast it into a bason full of cold water; when it has cooled to a consistence to bear such treatment, knead it well like the dough of bread, with the hands rubbed over with linseed oil, till all the parts be thoroughly incorporated with each other; then make the mass into a paste or cake, which may be either kept till some other convenient time in cold water, or immediately proceeded with in the following manner: Put the cake into an earthen dish or bason, the bottom of which should be rubbed with linseed oil, and pour on it water of the warmth of blood; let it stand a quarter of an hour, and as the water softens the cake it will let loose the finest parts of the calcined matter, which on gently stirring the water, but without breaking the cake or separating it into lesser parts, will be suspended in the water, and must be poured off with it into another vessel; the quantity of water must then be renewed, and the same operation repeated a second or third time, and as the mass appears slack in affording the colour it must be moved and stirred in the manner of kneading, with the ivory spatula, but not broken into fragments or small parts; and when so much of the colour is extracted as to render it necessary for the obtaining more, the heat of the water must be increased to the greatest degree, the quantities of the calcined matter (*which is now the ultramarine*) that were first washed off and appear of the same degree of deepness and brightness, may be put together, and the same of the second degree, the last washings making a third; the water then being poured off from each of these parcels, put on a lixivium formed of two ounces of salt of tartar or pearl ashes, dissolved in a pint of water, and filtered through paper after the solution is cold. This lixivium must be put on boiling hot, and the ultramarine stirred well about in it, and then the mixture set to cool; the powder being subsided, the clear lixivium must be poured off and clean water must be put in its place, which must be repeated till the whole of the salts of the lixivium are washed away; the ultramarine must afterwards be dried, and will be duly prepared for use. Ultramarine is subject to be adulterated on account of its great price. This is

frequently done by a precipitation of copper made by alkaline salt, and is very injurious, because the magistry of copper *(if the ultramarine sophisticated with it be used in painting either with oil or water)* will change its hue and turn black, and in enamel painting as soon as fluxed it will become, and consequently make the effect of the ultramarine vary from what is intended: this fraud may be easily detected by pouring some diluted spirit of nitre on a small quantity, which, if there be any copper will soon dissolve and a greenish blue solution.

Ultramarine Ashes.

After the ultramarine has been extracted from the lapis lazuli the residuum or remains form this pigment, and when the operation of extracting the colour has not succeeded well, a considerable share of the ultramarine will be left with the recrement and greatly enhances the worth of the ashes. It is prepared as follows:—Take the cement of the ultramarine which remains after the colour is extracted and mix it with four times its weight of linseed oil; let the mixture be set in a glazed pipkin over the fire, and when it is thus boiled a short time, put it into a glass vessel sufficiently large to contain it, of a cylindrical figure, of which vessel the diameter must be small in proportion to the length; but care must be taken that the matter when put into this glass be cool enough not to endanger the breaking it. This glass is then put into a balneum mariæ, which must be made as hot as possible without boiling, and kept there till the colour appears to be all subsided to the bottom. The oil must then be poured off till the colour begins to rise with it, and the remainder with the colour in it must be put into another glass of the same kind with as much fresh oil as will rise five or six inches above the colour. This glass must be treated in the same manner as the first, observing when the colour has subsided the oil must be poured off and a fresh quantity put in its place; this having been likewise poured off, the colour must then be well washed to free it from the remaining oil, first in boiling water and afterwards in some

of the lixivium before mentioned made boiling hot also; as much of the lixivium being poured off, when the colour has subsided, as can be separated from it that way, the colour must be thoroughly freed from the remainder by frequent ablutions with clean water; after which, the water must be taken off by the means before directed for the ultramarine, till the matter be of a proper degree of moisture for grinding; it must then be thoroughly well ground on a porphyry stone and washed over, that all the harder and insufficiently calcined parts may be reduced to an impalpable power; in order to which, the remaining grosser parts, after the finer have been separated, must be again ground till the whole be perfectly fine. Dry it as before directed for ultramarine.

Prussian Blue,

Is the earth of alum combined with fixed sulphur of any animal or vegetable coal and may be made from almost any animal substance, but is generally made from the coal of blood only: it is useful in all kinds of painting except enamel, and prepared to different degrees of brightness and strength. The common kind found in the shops and sold at very low prices can be little depended on in paintings of consequence, therefore it should be prepared perfect and in the true manner, and then considering the high price of ultramarine and the foulness of indigo it may be truly deemed a very valuable acquisition to the art of painting.

Take, of blood, any quantity and evaporate it to dryness; of this dry blood, powdered, take six pounds, and of the best pearl ashes two pounds; mix them well together in a glass or stone mortar; then put the mixed matter into crucibles or earthen pots, filled about two thirds, the crocks or crucibles being covered with a tile, but not luted. The calcination should be continued as long as any flame arises from the matter or rather till the flame becomes slender and blue, for if the fire be very strong a small flame would arise for a very long time and great part of the tinging matter would be dissipated and lost. When the matter has been sufficient-

ly calcined take the vessels which contain it out of the fire and as quickly as posssible throw it into two or three gallons of water, and as it soaks break it with a wooden spatula that no lumps may remain. Put it then into a proper tin vessel, and boil it for the space of three quarters of an hour or more; filter it while hot through paper in tin cullinders, and pass some water through the filter when it is run dry to wash out the remainder of the lixivium of blood and pearl ashes— the earth remaining in the filter may be then thrown away. In the mean time dissolve of clean alum four pounds, and of green vitriol or copperas two pounds, in three gallons of water; add this solution gradually to the filtered lixivium so long as any effervescence appears to arise on the mixture; but when no ebullition or ferment follows the admixture, cease to put in more. Let the mixture then stand at rest, and a green powder will be precipitated; from which, when it has thoroughly subsided, the clear part of the fluid must be poured off and fresh water put in its place, and stirred well about with the green powder, and after a proper time of settling this water must be poured off like the first. Take then of spirit of salt double the weight of the green vitriol which was contained in the quantity of solution of vitriol and alum added to the lixivium, which will soon turn the green matter to a blue colour; and after some time add a proper quantity of water, and wash the colour in the same manner as has been directed for lake, &c. and when properly washed, proceed in the same manner to dry it in convenient lumps. The brightness, deepness, and coolness of Prussian blue, are proofs of its goodness; for, with these qualities, it may be depended on for standing well. Sophistication, or any thing amiss, may be seen by its being more foul and purple.

Verditer.

Take any quantity of chalk, and having rendered it sufficiently fine by washing over carefully, add it gradually to the solution of copper so long as any change appears to be produced by it from the ebullition excited, or the due proportion may be perceived by the fluid

losing its green tinge and becoming colourless. Let it then stand at rest till the sediment be subsided, and pour off the clear part from the sediment or powder, adding in its place clear water, which must be several times renewed till the salts be entirely washed out. The sediment, which is the verditer, must be afterwards freed from the fluid by filtering through paper covered with a cloth, and laid out in lumps of a middling size to dry.

Those who desire to make verditer themselves, may prepare the solution of copper by adding copper filings gradually to aqua fortis of any kind, or putting plates of copper in it, and proceeding as for refiner's solution.

Sander's Blue.

Dissolve copper in aqua fortis as above directed, add to it starch finely powdered, the proportion of one-sixth of the weight of the copper dissolved; make then a solution of pearl ashes and filter it and put gradually to the solution of copper as much as will precipitate the whole of the copper, which may be known by the fluid's becoming clear and colourless, though before highly tinged with green wash; the precipitated powder in the manner directed for lake, and drain it well from water by means of a filter, lay it out to dry.

Class 3d.—*Yellow Colours.*

King's Yellow.—Take of arsenic powdered and flour of sulphur in the proportion of twenty of the first to one of the second, and having put them into a sublimer, sublime them in a sand heat; the operation being over, the king's yellow will be found in the upper part of the glass, which must be carefully separated from any caput mortuum or foul parts that may be found in the glass with it—it must be afterwards reduced to an equal powder.

Naples Yellow

Is a yellow rather inclining to the orange red found in the neighborhood of Naples. There must be no iron

allowed to touch it in the working; therefore, when ground, it must be worked with an ivory spatula.

Yellow Ochre

Is a mineral earth, found in different places, of various degrees of purity. There is no other preparation necessary but levigation and freeing it properly from dirt and other matter.

Dutch Pink.

Take of French berries one pound, and of turmeric root powdered four ounces; boil them in a gallon of water two hours, and then strain them through flannel, and boil it again with an ounce of alum till it be evaporated to one quart; prepare in the mean time four pounds of chalk by washing it over, and afterwards drying it, and mix the chalk with the tincture by drying, say grinding it with it, and then lay out the Dutch pink thus made to dry on boards. It should be a full gold colour yellow.

English Pink

Is prepared in the same manner as the foregoing and with the same ingredients, only increasing the quantity of chalk to render it of an inferior quality, it being the same, only lighter and coarser.

Light Pink.

Take of French berries one pound, boil them with a gallon of water for an hour, and having strained off the fluid, add to it two pounds of pearl ashes, dissolved and purified by filtering through paper, precipitate with alum dissolved in water, by adding the solution gradually so long as any ebullition shall appear to be raised by the mixture; when the sediment has thoroughly subsided, pour off the water from it and wash it with several renewed quantities of water, proceeding as has been

before directed in the case of lake, drain off the remaining fluid in a filter, with a paper covered with a linen cloth, and lastly dry it on boards in small square pieces.

Gamboge.

No yellow is of greater service in water colours, easily dissolving to a milky consistence from the state in which it arrives. It is a gum produced in the East Indies, and nothing but the addition of water is wanting to prepare it for use.

Masticote

Is made by putting white lead or flake white on an earthen or stone dish by the fire, or before a strong fire till it becomes sufficiently yellow. The calcination being finished, the parts which are of the desired tint must be picked out from the rest and put together, for with the greatest care it is difficult to calcine the whole. Equally grinding with oil is the only preparation necessary to the using it.

Common Orpiment.

It is generally disagreeable to meddle with. This, on account of its nauseous smell and poisonous quality, being a fossil body, composed of arsenic and sulphur, with a mixture frequently of lead and sometimes other metals in its unrefined state, it is only useful to colour the matted body or bottoms of chairs, or other coarse work; but if purified by sublimation, it becomes a king's yellow.

Gall Stones.

The real kind are found in the gall bladder or like ducts of beasts, and require nothing more than rubbing with water *(like gamboge)* to dissolve them to a dark warm yellow; but as these are not easily procured

a fictitious kind, of equal service, may be made as follows:—

Take a quart of the bile of an ox, as fresh as possible; put it into a proper pewter vessel, and set it to boil in a balneo mariae; having added to it a quarter of an ounce of clear gum Arabic, evaporate the whole to about an eighth, and then remove it into a china cup or bason of proper size, and evaporate it to dryness, collecting it into a mass as it becomes of a stiff consistence.

Turpeth Mineral.

Take of pure quicksilver and oil of vitriol, each six pounds; put them into a retort, to which *(being placed in a sand bath)* fit a receiver, and distil them with a strong fire while any fumes appear to arise into the receiver, urging it at last with as great heat as the furnace will bear, when the retort is again cold, remove it out of the sand bath, and having broken it, take the white mass which will be found at the bottom of it, and break it to a gross powder, and having put it in a glass mortar, pour water on it, which will immediately convert it to a yellow colour; let it next be thoroughly ground in this mortar with water, and afterwards washed with several successive quantities; it must then be thoroughly well levigated on a stone, and dried.

The Yellow Wash from the French Berries.

Take one pound of the French berries, and put to them a gallon of water, with half an ounce of alum: boil them an hour in a pewter vessel, and then filter off the fluid, through paper, if it be designed for nicer purposes—flannel for more ordinary. Put them again into the boiler, and evaporate the fluid till the colour appears of the strength desired; or part may be taken out while less strong, and the rest evaporated to a proper body.

Turmeric Wash.

Take two ounces of proof spirit, and add to it one ounce of water: put into a proper phial, add 2 drachms

of turmeric root in powder. Shake them well together, and let them stand three or four days, shaking it often; and a strong tincture will be formed.

Tincture of Saffron

Is made by steeping saffron leaves in hot water, and afterwards filtering through a cloth, and then kept in a phial.

4th Class.—*Green Colours.*

Verdigris is made by dissolving copper in strong vinegar or other acids; but as it may be procured at any of the shops cheaper than it can be manufactured on a small scale, the process is here omitted.

Sap Green.

Take a quantity of buckthorn berries, before they are ripe, and press out the juice; strain it through flannel, and let it stand to settle. After it has settled pour off the fluid from the sediment. Put this fluid into a glass or earthen vessel, and evaporate it to thick consistence, then remove it to a pewter vessel, and finish the evaporation in a balneo mariae, or water bath, collecting the matter into a mass when it is thick enough to form into cakes.

Prussian Green.

Proceed in all points as in the process given for *Prussian blue*, till the solution of alum and vitriol be mixed with that of the pearl ashes and sulphur of the coal, and the green precipitation made. Then, instead of adding the spirit of salt, omit any further mixture, and go on to wash the sediment, *which is Prussian green;* and afterwards dry it in the same manner as is directed for the blue.

Serra Verte.

This is a native earth, of a coarse texture, and needs no other preparation but to be well levigated and washed over.

Class 5th.—*Purple Colours.*

True Indian Red.—This is a native ochreous earth, and needs no preparation but that of grinding and washing. There is a fictitious kind, known by the same name, but it is not a good purple.

Archal.

This colour is not in high repute; but it may be made in the following manner:—Take 1 oz. of archal weed or moss, and bruise it well; put it in a glass phial with half a pint of weak spirit of sal ammoniac, distilled with lime. Stop the phial close, and leave the archal to infuse till a strong bluish purple tincture be formed.

Class 6th.—*Of Brown Colours.*

Brown Pink.—Take French berries 1 lb. fustic wood in chips half a pound, and of pearl ashes 1 pound: boil them in a tin boiler, with 1½ gallons of water for an hour, and then strain off the tincture through flannel while boiling hot. Having prepared in the mean time a solution of a pound and a half of alum, put it gradually to the tincture so long as ebullition shall appear. Proceed then to wash the sediment in the manner directed for the lake colours; and being brought to a proper consistence by filtering through a paper with cloth, dry it on boards in cakes or balls.

Bistre.

This is a good brown for water colours, and is made as follows:—Take a quantity of soot, made by burning dry *beech wood;* put it into water, two pounds to a gallon, and boil it half an hour; then let it stand a little to

settle, and pour off the clear part while yet warm from the sediment at the bottom; and if, upon longer standing, it forms another earthy sediment, pour off as before; but this must be done while the fluid is hot. Evaporate this fluid to dryness, and it will be good bistre, if the soot was good.

Brown Ochre, or Oker.

This colour is commonly procured from the shops, after which it should be well levigated and washed over. It stands well.

Cologn, or Collin's Earth.

This is a fossil substance, of a blackish brown colour, and needs no preparation except that of grinding it very fine with water.

Japan Earth.

This is a gummy kind of substance, extracted from a vegetable. It is to be dissolved in water for use, but does not mix well with oil.

Umber

Is much used with drying oils, for japanning, gold size, black oil lacquer, &c. but it must be burned, levigated, and washed over before it works well with water.

Extract of Liquorice, or Spanish Juice,

Is used for a brown, and answers the purpose of bistre, but is not so good.

Class 7th.—*Of White Colours.*

Flake White.—This colour is much used for oil or varnish painting, where a very clear white is wanted. It is a kind of *ceruse*, or *lead*, corroded by acid. It is best to procure the white flake in the lump (which is sold at a moderate price) and then levigate, and add so

much starch to it while grinding, as will render it suitable to work with.

White Lead.

This is also made by corroding plates of lead with *acid.* It is procured at a moderate price, and ought to be washed over. It is sometimes adulterated with chalk, and is inferior to the white flake. Used with oil for painting on wood, &c.

Calcined or Burnt Hartshorn.

Take hornes or bones, and burn them in a common fire till they become a coal, or calcined to whiteness; free them from dirt or coal that may stick to them, and reduce to coarse powder; then put them in a vessel of the form of an earthen dish of ground crucible and Stourbridge clay, well dried, put the whole in a potter's oven, or furnace, as long a time as would suffice to bake their pots. After this, the horn or bones being now well calcined, should be well levigated with water, and then washed over. This is superior to flake white, or white lead, for painting.

Pearl White.

This is the purest, and whitest part of burnt oyster shells, well levigated, and washed over. It is much used in miniature painting.

Troy White, or Spanish White,

May be used in water colours, and is prepared as follows:—Soak a pound of chalk well in water, and wash over all the fine part; then having poured off the first water, add another in which two ounces of alum have been dissolved Let them stand for a day or two, stirring every 6 or 8 hours. Wash the chalk over again, till it be rendered very fine, and pour off the water, taking away the rest of the dissolved alum by repeated quantities of fresh water. After the last water is pour-

ed off, put the chalk into a cullinder filter, with a linen cloth over the paper, and when the moisture has been sufficiently drained off, lay it out in lumps to dry on paper or a board.

Eggshell White

Is made of the finely powdered egg shells after the inner skin has been peeled off. It should be washed over before used, and is then preferred by some to flake white.

Class 8th.—*Of Black Colours.*

Lamp Black.—This is the soot produced by burning oil in a confined place. It mixes well with either oil or water, and is the principal black used in the finer kinds of painting.

Ivory Black.

Take chips, or shavings of ivory, and soak them in linseed oil. Put them into a vessel that will bear the fire, and cover it with a lid made of cl-y and sand, which should be dried, and the crack stopped before the vessel be put into the fire. Put this vessel in a furnace, such as a potter's or pipe-maker's, and let it remain there one of their heats. When taken out well burnt, it must be very finely levigated on a stone with water; and if it is washed over, it will be still better than without washing.

Indian Ink.

The best Indian ink is brought from China in small cakes; but an imitation of this is made as follows:—

Take 6 ounces of isinglass, dissolve to a size in 123 of water over the fire. Take Spanish liquorice one ounce; dissolve it in 2 ounces of water, and grind it up with one ounce of ivory black prepared as above. Add this mixture to the size while hot, and stir the whole till the ingredients are well incorporated. Evaporate

away the water, and make up the residuum into balls, or cast it in moulds made of lead, and greased before using.

Of Compound, or Mixed Colours.

Calcined green colours, to be laid on *prints*, must be ground with vinegar; but other colours are generally ground up in gum water, and by a proper mixture of the foregoing *prime* colours, a very great variety of compound, or intermediate colours may be made.—Thus:

Blue and yellow make a green;
Blue and red, purple;
Yellow and red make an orange, &c.

1. For the human face, a mixture of white and vermilion; for the lips, a mixture of lake and vermilion, and shades are made with white, vermilion and umber.

2. For fair hair, much white and a little umber; a variety of colours, take yellow ochre and brown red, and shade with bistre and lake if light, only mix some black, white and umber.

2. Clothes of linen, white and a little blue; shades, with a size made of white lead and a little black together. Red cloth, use vermilion in the lighter parts of the folds, lake and vermilion for the lighter shades, and lake alone for the darker shades.

4. A pale yellow for lights is made with white massicot. The *chiaro obscuro*, with massicot and umber. The dark shade with umber alone.

5. Orange colour is made with black lead for the lights, and shade with lake.

6 Lake is used very clear for lights, in draperies, and thicker for the shades.

7. Purple is made with blue, white, and lake for the lights, and blue and lake for the clear shades, and indigo and blue for dark shades.

8. Pale blue is used for lights, and for clear shades a little thicker.

9. A *gold-like yellow* is made with yellow massicot for the lights; and the clear shades with a mixture of black lead and massicot; the darker shades with lake,

yellow ochre, and a very little black lead; and the darker with Cologn earth and lake.

10. Greens are of two sorts. The first made with massicot and blue, or blue and white; and for the shades make the blue predominate in the mixture. The other is made with calcined green; and French berries' juice, mixed and calcined green, and shaded by the addition of indigo.

11. For trees mix green and umber together.

12. Grounds are made in the same way. Where there are any greens, take calcined green and French berry juice.

13. For distant skies, mix green and blue; and mountains are always of blue.

14. The skies are also made with blue; but a little yellow is added near the mountains; to make the transition between that and the blue, mix a little lake and blue together to soften it.

15. Clouds are made with purple; if they are obscure, you may mix lake and indigo together.

16. Stones are made with white and yellow mixed, and shaded with black.

17. For horses, take bistre, ochre, and white. Dark brown horses require a little black. Grey ones, bistre and white only.

18. Red lead, massicot, and a little whiting, make a *flame* colour.

19. Spanish brown and white, a *hay* colour.

20. Indigo, white, and Spanish brown, a purple.

21. Smalt and pink, with a little white, make a light green; without the white, deep green.

22. Indigo and white make a sad or lead colour.

23. Indigo, lake, and white lead make a *violet*.

24. White and a little yellow make a straw colour.

OF STAINING WOOD, &c.

To Stain Wood Yellow.

1. TAKE any white wood, and brush it over several times with a tincture of turmeric root, made by putting an ounce of the root in powder to a pint of spirit; and after they have stood some days, straining off the tincture. If the colour be desired of a reddish cast, a little dragon's blood may be added. Or,

2. Rub over the wood several times with a tincture of the French berries, (*see the "Yellow Wash," page* 142,) made boiling hot. After the wood is again dry, brush it over with a weak alum water, used cold.

For lesser pieces of wood, they may be soaked in the tinctures instead of being brushed over.

3. Wood may also be colored yellow by brushing it over with aqua fortis; if it be used *pure*, and the wood cold, it will produce a dark or brown colour; but if it be diluted with water, or the wood warm while using it, the colour will be lighter. It is by this method that gun-stocks receive a beautiful yellow or orange colour. A little oil is rubbed over after the aqua fortis has set the colour and the wood again become dry.

Sometimes a coat of sud or shell-lac varnish is laid on after the colouring, which renders them both durable and beautiful.

To Stain Wood Red.

1. Put one pound of Brazil wood in a gallon of vinegar, stale urine, or water in which an ounce of pearl ashes has been dissolved. Let this infuse for two or three days, stirring it often. It should be brushed over the wood while boiling hot, and then while wet, brushed over with alum water of a consistence of two ounces of alum to a quart of water.

2. Dissolve 1 ounce of dragon's blood in a pint of spirit of wine. This is nearly equal to a lacquer.

3. For a pink red, add 2 ounces more of the pearl ashes to the above solution of Brazil wood, and brush often over with a stronger alum water Then varnish when dry.

Staining Wood Blue.

1. Take the solution of copper, (see Sander's Blue, page 139,) and brush it over while hot, several times; then take 2 ounces of pearl ashes to a pint of water, and brush it over after the other till it produces a fine blue colour.

2. Wood may be stained green by verdigris, and then turned to a blue by the pearl ashes, as above.

3. Take indigo prepared with soap lees, as used by the dyers, and brush the wood with it while boiling hot. Then boil 3 ounces of white tartar or cream of tartar, to a quart of water, to solution, and brush it over copiously before the indigo tincture be quite dried out of the wood.

These colours may afterwards be varnished as the yellows.

To stain Wood a Mahogany Colour.

1. For light mahogany colour, take half a pound of madder, and a quarter of a pound of fustic wood, ground in water, say one gallon; (or, instead of the fustic, one ounce of the French berries may be used.) This must be brushed over the wood while hot, till the desired colour be obtained.

2. Nearly the same effect may be produced by the tincture of *dragon's blood*, and turmeric root in spirits of wine. By increasing or diminishing the proportion of the ingredients, the brown colour may be varied to a more *red* or *yellow* cast at pleasure.

This succeeds better upon dark than upon light-coloured wood.

3. For the dark mahogany colour, take the infusion of madder as above, and two ounces of logwood instead of the fustic; and when the wood has been several times brushed over with it, and then dried, it must be slightly brushed over with water in which pearl ashes have been

dissolved, in proportion of about one-fourth of an ounce to a quart of water.

Several intermediate colours may be made by varying the proportion of the forementioned ingredients; and for very fine work, two or three coats of *sud-lac*, or for coarser work, of *shell lac* and *resin varnish* should be laid over the colours, and then rubbed over with drying oil.

To stain Wood Green.

Dissolve verdigris in vinegar, or crystals of verdigris in water; and while hot, brush it over the wood till it be duly stained; then after it is dry, varnish, &c. as above.

To stain Wood Purple.

Take one pound of logwood to one quarter of a pound of Brazil wood, and one gallon of water boiled an hour or more, and brush over the wood till a proper colour is given; after which pass over it a solution of pearl ashes, (say one drachm to a quart of water.) This solution must be used with caution, or it will change the colour from the brown red to a dark blue purple, if too plentifully used.

To stain Wood Black.

Brush the wood over with the decoction of logwood above several times, but without the Brazil wood in it. Then prepare an infusion of one fourth of a pound of powdered galls, in two quarts of water, set in a warm place for two or three days, and brush the wood over with it three or four times; then with a solution of green vitriol of two ounces to a quart of water, pass over the wood again. This is a cheap method.

2 Brush the wood over several times with a solution of *aqua fortis* and copper, and afterwards with the decoction of logwood, which must be repeated till the colour is sufficiently deep, and the greenness produced by the solution of copper, wholly overcome.

It may be observed, that if the wood be *soaked* in the solutions prepared for the several colours, instead of being *brushed* over, the colours will be more permanently set in the substance.

Also, that the wood should be dried between each of the brushings; and may be varnished or oiled after the last brushing and is well dried in.

To Stain Ivory, Bone, or Horn Yellow.

1. Boil them in a solution of alum in proportion of one pound to two quarts of water; and then prepare a tincture of half a pound of pounded French berries to a gallon of water, with a quarter of a pound of pearl ashes. After this has boiled about an hour, put the ivory, &c. in it, and let it remain there half an hour.

2. If turmeric root be used instead of the French berries, a brighter yellow will be obtained; but in this cast, the ivory, &c. must be again dipped in the alum water after it has been taken out of the tincture, otherwise an orange colour instead of a yellow, will be obtained, from the effect of the pearl ashes on the turmeric.

To stain Ivory, Bone, or Horn Green.

Put half a pound of the raspings of Brazil wood in a gallon of strong lime water, and let them boil for an hour; then put them in the ivory, &c. (having been previously boiled in the alum water as above, for the yellow,) and let it continue there until the colour is set in. If it verge towards a crimson or purple colour, dip it again in the alum water.

To stain Ivory, &c. Blue.

First stain it a green, as above directed, and then dip it in a solution of pearl ashes, made strong and boiling hot; but do not dip any oftener, nor let it continue longer than just to turn the green to a blue.

2. Ivory, &c. may be boiled in a tincture of indigo, as prepared by the dyers, and then in a solution of tartar made as directed for staining wood.

To stain Ivory, &c. Purple.

Treat them in the same manner as for red, except that *logwood* must be used instead of *Brazil wood*, and the use of the alum water entirely omitted.

2. For a redder purple, use a mixture of logwood and Brazil wood, instead of the logwood alone.

To stain Horn, so as to imitate Tortoise Shell.

After the horn is pressed into a proper form, make a paste of two parts quick lime and one part litharge (mixing a little whiting on that which is to cover such parts of the horn as is to be left of a lighter shade) and cover such parts of the horn with the paste as you wish to have the dark colour. Let this remain on the horn till dry, and then brush it off, when the parts which were thus covered will resemble the colour of the shell.

To stain Ivory, Bone, and Horn, Black.

Proceed in the same manner as directed for wood.

To stain Parchment or Paper Yellow.

1. Use the tincture of French berries; or
2. Infuse one ounce of turmeric root in a pint of spirits of wine; and if you want it of a redder colour, add a little annatto or dragon's blood to the tincture

In staining paper or parchment, it is best to put the tincture over it with a brush.

To stain Paper or Parchment Red.

Proceed as for *wood*, or use red ink, or a tincture of dragon's blood, or a tincture of Indian lake in spirits of wine, infused for a few days, will give a beautiful *crimson* colour.

To stain Paper, &c. Green.

Use an infusion of verdigris in vinegar, or crystals of verdigris water, or a solution of copper in aqua fortis, adding filings of copper till the ebullition ceases.

To stain Paper, &c. Blue.

First make it a green, and then turn it to a blue as directed for *wood*, or by the use of indigo.

To stain Paper, &c. an Orange.

First stain it a yellow, and then brush it over with a solution of half an ounce of pearl ashes or salt of tartar in a quart of water, and filtering the solution.

To stain Paper, &c. Purple.

Make use of archal, or tincture of logwood, (as for staining wood) or the juice of ripe privet berries.

To stain Alabaster, Marble and other Stones, &c.

These may be made any colour, the same as directed for wood; but the liquid should be *poured* on them boiling hot instead of brushing it over. When tinctures of spirit of wine is used, it must be cold, otherwise it will evaporate and leave the colours imperfect.

The York Tan and Limerick Dye, &c.

These fashionable colours are set in gloves, leather, &c. by steeping saffron in boiling hot water for twelve hours; and having the gloves, &c. sewed up to keep the colour from getting to the inside, they are brushed or rubbed over with a sponge dipped in the tincture.

The strength of the colour depends upon the quantity of saffron used; but a teacup full of the infusion is sufficient for a single pair of gloves.

VARNISHES.

VARNISHES are those smooth, glossy, enamel-like coverings which are laid on metals, wood, leather, paper, &c for the purpose of adding to the beauty of their surface, and to preserve them from the effects of dampness, dust, &c.

Thus lacquers, Japan liquors, &c. are a kind of varnishes, as well as those used by cabinet-makers for their furniture, and the map and picture-makers to preserve their works from being soiled by dust, flies, &c.

To make a good Copal Varnish, say 1 gallon.

1. Take three fourths of a pound of clean rosin pulverized, one quart of linseed oil, one pound of gum copal pulverized, a quarter of a pound of sugar of lead: mix them all together, dissolve, and boil over a clear, slow fire, till of a proper consistence; then add two quarts of spirits of turpentine when about to use the varnish.

It may be observed that all articles used for varnishes, should be of the purest and best kind which can be had.

A perfectly Transparent Varnish.

2 Dissolve gum copal in a warm place, with the essential oil of bergamotte, lavender, orange, lemon, or rosemary, (the last of which is the cheapest;) then dilute it with twice its quantity of highly rectified spirit of wine. If the oil of rosemary is adulterated with turpentine, it will not succeed well.

3. Oil of turpentine digested on copal in a small retort and a lamp heat for 12 hours, has been found to produce a very good colourless varnish.

4. To one quart rectified spirits of wine add two ounces of mastic, in drops, and six ounces of sandarac; when well dissolved, add four ounces of pure Venice turpentine. Very good for toilette boxes, &c.

5. To a quart of spirits of wine put six ounces of sandarac, two ounces of gum lac, half an ounce of gum elemi, and 2 ounces of clear white rosin.

This is a very good varnish for furniture, canes, &c.

A Varnish for Violins and other Musical Instruments.

6. Take one quart of spirits of wine, four ounces of sandarac, two ounces of gum lac, two ounces of mastic, and one ounce of gum elemi; and when well incorporated, add two ounces of good turpentine.

A Gold-coloured Varnish, or Lacquer:

7. Take 8 ounces of amber, 2 ounces of lac; melt them, and add 8 ounces of drying oil: after this add oil of turpentine coloured with gamboge, annatto, saffron, and dragon's blood, according to the tinge you wish the varnish to have.

A Black Varnish or Japan.

8. Melt 8 ounces of amber, and (separately from the amber) 4 ounces of asphaltum, and 4 of rosin; when melted, add 8 ounces of boiling oil (say linseed) and then 16 ounces of oil of turpentine. After this, stir in near an ounce of lampblack, and boil it a little more.

A Common Varnish.

9. One pound of rosin, one ounce gum elemi, eight ounces linseed oil and one pound of oil of turpentine.

To make Copal Varnish.

10. Take one pound gum copal, three-fourths of a pound of rosin; dissolve them together over a slow fire: when completely dissolved, add one quart of linseed oil, well boiled; then boil them over a slow fire for fifteen minutes; then add one and three fourth ounces sugar of lead; then boil it about five minutes more, stirring

it well, and it is completed. Reduce it to a proper consistency with spirits of turpentine. It will require about two quarts of turpentine, and you will have a gallon of good varnish.

A True Copal Varnish.

X X 11. Take 2 parts of gum copal, reduced to a fine powder; wash it repeatedly to free it from its woody fibres. Put it into a bottle, over four parts of pure oil of rosemary: digest the mixture in a moderate heat for three or four days; then add as much spirit of wine as is necessary, and let it stand till all the impurities subside, and then decant off the varnish.

To make a White Varnish.

X 12. Dissolve gum sandarac and gum mastic in spirits of wine, and let it settle 2 or 3 days; then strain it through a clean linen cloth, and let it stand for some time; after which pour off the clear liquid and bottle it for use.

Another White Varnish.

X 13. Take 1½ oz. gum sandarac, ½ oz. mastic in drops, ½ oz. gum elemi, and ½ oz. oil of spike lavender; put the whole into a half pint phial, and fill it up with best spirits of wine. Let the whole stand in a warm place till the gums are dissolved, and then pour off the varnish into a clear phial for use.

A Sud Lac Varnish.

14. Take 1 quart spirit of wine, put it into a wide mouth bottle, and add 8 ounces of sud lac, bright and clear let it stand 2 or 3 days in a warm place, often shaking it; then strain it through a flannel into another bottle, and it is fit for use.

A Shell Lac Varnish.

15. Take one quart good spirits of wine, 8 ounces of thinnest and most transparent shell lac; mix and shake them well together, and let them stand two days, and it is ready for use.

This is softer than the sud lac varnish, but does very well to mix with it for varnishing on wood.

A good Linseed Oil Varnish.

16. Take one pound of well pulverized and sifted litharge, four ounces finely powdered white vitriol, and one quart of good linseed oil. Put the whole into an iron pan that will not be more than half full. Mix well, and boil them till the moisture is evaporated, which may be known by a goose quill which will then burst if thrust to the bottom of the boiling varnish. Take it off the fire and pour off the clear liquor carefully so as to leave the thick part which is at the bottom. While boiling, it should be stirred several times round, that the litharge may not fall to the bottom; but stir it constantly, else superfluous litharge will be dissolved, and the varnish become too thick

Amber Varnish.

17. Take half a pound of melted or roasted amber, one pound and a half of the above linseed oil varnish, and two pounds of turpentine oil. Mix the amber and oil varnish in a deep cast iron vessel that will not be more than one-third full, and keep over a slow fire till the amber is dissolved, which may be known by its swelling up; then take it from the fire, and when cool add the turpentine oil, stirring continually as you pour it in. Then let it stand till well settled; then pour off the clear varnish, strain it through a piece of linen, and put it in a bottle for use.

Care should be taken to have a vessel ready, if the varnish should boil over, to set the boiling vessel in and preserve what would otherwise be wasted; and a board or iron cover should be at hand to lay over the top of

the boiling vessel, for the purpose of extinguishing the flame in case it should take fire while boiling.

Another Black Varnish.

18. Gum lac 4 ounces, sandarac one ounce, black rosin one ounce—pulverize all separately. Dissolve the rosin in a sufficient quantity of spirit of wine, and then add the sandarac to it, and when it is melted add the gum lac, and stir well till it is melted; strain through a cloth; put a drachm of ivory black to each ounce of the varnish, and boil a little more in a clean vessel.

A Varnish for Copper Plate Prints or Maps.

19. First lay on a coat of water (in which some isinglass has been dissolved) with a very fine brush; then another made of true spirit of wine, half a pound; gum elemi, two drachms; and sandarac, three drachms, dissolved together.

An Admirable Varnish.

20. Take white mastic and linseed oil a sufficient quantity; a little turpentine, pounded glass, burnt verdigris, and pounded amber. Boil and melt the whole together in a new earthen pot.

A Varnish in which may be put any Colours at pleasure.

21. Take one ounce aspic oil one do. turpentine, four drachms clean sandarac pulverized, two drachms gum copal: the whole being well pulverized, put it into a matrass and add half a pound of spirits of wine, and set it in a balneo mariae (or vessel of hot water.) When the whole is dissolved, strain it, and put in a glass bottle well corked for use.

A Chinese Varnish, suitable for all Colours.

22. Take 1 oz. white amber, $\frac{1}{4}$ oz. gum sandarac, $\frac{1}{4}$ oz. gum copal: pound them together, and put them

dry into a matrass: then to each ounce of this mixture put three ounces of spirit of wine, then stop the vessel well, and boil it over the embers till the whole is dissolved. Then dissolve your colours in aqua vitæ with some isinglass, and lay it on the article after it has been well polished. When the colour is dry, lay on two or three coats of the above varnish, allowing time to dry between each coat; and then polish over with olive oil and tripoly, and rub the oil with a rag.

A Water-proof Varnish.

23. To 1lb of pure linseed oil in a clean glazed earthen pipkin, add ½lb of rosin, the purest that can be had; and boil well over clear coals of fire, (it should boil moderately lest it should run over) till well dissolved, and till a little of it taken out on the end of a stick will draw out like a thread. If it be too thin add a little more rosin, but remember that both the oil and the rosin must be very pure, and boiled a long time or the varnish may not be good. This varnish must be dried in, in the sun shine, as the shade is not sufficient to do it in due time.

A beautiful Chinese Varnish.

24. To one ounce of white amber, or whitest gum-copal and 4 drachms of sandarac, add 2 drachms of fine mastic, in drops; reduce all to a fine powder and put into a glass bottle, then pour over it enough of finest oil of turpentine, say one ounce. Stop with a cork, and tie a piece of wetted bladder over it; let these infuse over a slow fire for 12 hours: Uncork the bottle, let it cool, and then pour in gently 6 ounces of pure spirits of wine, and cork up as before: Then put it into a vessel of hot water for 12 hours more; when the spirits will have dissolved the gums, and before it gets cool, strain it off, and put it in a bottle and cork it well for use.

A Varnish for Bronzing.

25. One ounce of finest shell lac in very fine powder is to be put into a bottle of 1½ pint size, and half a pint

of best spirit of wine added; stop it well, and set it in a cool place for four days, that the lac may dissolve slowly, shaking the bottle four or five times a day, and if not then dissolved, set it in a warmer place.

Note.—Pour the spirit of wine on leisurely, a little at a time, shaking between each time that it may mix well.

1. It should be remembered, that in making spirit-varnishes, the vessel should never be more than three quarters full, and that, in general the *balneo-mariae* or *hot water* bath is the most proper heat for dissolving the gums in the spirit; while a sand bath or good clear fire may be used for oil varnishes: but in every case the materials should be kept entirely free from all dust and filth, and that none but the purest kind should be used, if good varnish is wanted.

2. It is a common practice of those who make varnishes for sale, to leave them too thick for immediate use; in which case it is necessary to add a little turpentine spirits or other proper ingredient to bring them to a proper consistency for working well.

3 It is customary for workmen, especially cabinet-makers. first to stain their furniture *(see staining of wood, page* 150,*)* some suitable colour, and then to lay a light-coloured varnish over it.

An excellent Varnish to lay on Prints.

One quarter of a pound of good Venice turpentine, diluted with a gill of spirit of wine: if too thick, put in a little more spirit; if too thin, a little more turpentine, so as to make it of the apparent thickness of milk, and lay on one, or, if necessary, two coats on the face of the print, or map, and it will stand water, and shine like glass.

METALS.

AMONG the simple substances which present themselves to our view in examining the products of nature, there are none of which the study is more important than that of METALS. Their utility is highly interesting, and they may be considered as the great instruments of human industry.

We are at present acquainted with twenty-nine metals, essentially differing from each other, namely:—

Platina,	Antimony,	Molybdena,
Gold,	Bismuth,	Tungsten,
Silver,	Manganese,	Arsenic,
Copper,	Nickel,	Tantalium,
Iron,	Nicholinum,	Cerium,
Lead,	Cobalt,	Palladium,
Tin,	Uranium,	Rhodium,
Zinc,	Titanium,	Iridium, and
Mercury,	Columbium,	Osmium;
Tellurium,	Chrome,	

Of each of which I shall now give a short natural history, together with the art or method used in extracting them from their ores, &c. which is usually called Metallurgy.

All metals are found in the bowels of the earth, and sometimes on its surface. They are met with in different combinations with other metals, such as sulphur, oxigen, and acids; particularly with the carbonic, muriatic, sulphuric, and phosphoric acids. They are also found combined with each other, and sometimes, though rarely, in a pure metallic state. The ores of most metals are usually found in mountainous countries, and often running in a chain for a considerable distance. Some mountains indeed have been found to be almost entirely composed of iron ore. They are sometimes found in strata or veins, in the crevices of rocks, and in some instances in low level lands.

The art of distinguishing ores, and the method of describing them with accuracy and precision, is called

"Mineralogy," and the art of extracting the metals therefrom is called "Metallurgy."

Platina.

No mine of platina has ever yet been discovered. It is found in nature only in a metallic state, in small grains, combined with palladium, rhodium, iridium, osmium, iron, copper, &c. the largest pieces not exceeding in size a pigeon's egg. It is found in many places in South America; but was not known in Europe before the year A. D. 1748. Pure platina is of a white colour, between that of silver and tin: it is the hardest and heaviest of all metals; its specific gravity being at 20.6 to 23, pure water being at 1.0. It is malleable, ductile and laminable, like gold, and may be drawn into wire of not more than the two-thousandth part of an inch in diameter.

Method of obtaining Platina.

1st. Take equal parts of platina in grains, and acidulous tartrite of pot ash; put the mixture into a well-luted crucible, and expose it for two hours to a violent heat. The platina fuses, but becomes brittle, and whiter than its common colour; then expose it to a very strong heat under a muffle, by which means all the arsenic combined with it will be disengaged, and the platina will remain behind in a malleable state.

2d. Platina may likewise be obtained pure by decomposing the nitro-muriatic solution of common platina by muriate of ammonia, heating the precipitate intensely, and stamping it when of a white heat into one mass, or by assisting the fusion with a stream of oxigen gas.

Gold.

Gold is found in nature only in the metallic state, most commonly in grains, ramifications, leaves, or rhomboidal, octahedial, or pyramidical crystals. It is found also in the sand of rivers in Africa, Europe, and South America, in minute, irregular grains, called gold dust. Some small quantities have been found in Vir-

ginia and other places in the United States. The largest piece of native gold hitherto found in Europe was discovered in the county of Wicklow in Ireland, weighing 22 ounces, almost pure. Some French chymists have obtained gold from the ashes of vegetables.

Gold is of a brilliant yellow colour, and is the heaviest substance known, platina excepted, its specific gravity being 19.3. Its ductility is so great that a wire of one-tenth of an inch in diameter will support a weight of 500 pounds, which is much more than any other metal would support, and it is also more malleable than any other metal. It has been proved that one grain of gold may be divided into 28,000,000 of parts which will all be visible to the naked eye; and that 16 ounces of gold, which, in the form of a cube, would not exceed 1$\frac{1}{4}$ inch in diameter, would gild a silver wire of sufficient length to go round the whole earth like a hoop.

Method of obtaining Gold.

Native gold (which is nearly pure) is, together with its matrix or substance which incloses it, to be pounded fine and well washed with water, by running it over a piece of cloth with a long nap, which will retain the heavy particles of gold while the others are carried off: it is then mixed with 1-10th mercury, and triturated in an iron or copper vessel containing boiling water, until the mercury has absorbed all the particles of gold. The mercury thus containing the gold in solution, is to be separated first from the water, and next from the earthy particles, and then from the sand, by throwing the whole upon a table, placed in an inclined position; the mercury charged with gold, but still vivid, will, when assisted by a little stirring, run off the table and leave the sand behind. The mercury is then separated from the gold and silver (if any) by exposing the alloy in earthen retorts, to such a heat as will occasion the mercury to distil off, and is collected again in a receiver with water. The gold not being volatile in fire, is thus left behind, and is afterwards farther freed from the heterogeneous imperfect metalic substances by the process of cupellation. *(See Cupellation)*

When gold ore is free from sulphur, it may, after being pounded and washed, be melted with one and a half parts of semi-vitreous oxyde of lead, and three parts of glass, in a crucible covered with muriate of soda. By this operation all the heterogeneous metals will scorify, and set the gold free.

Gilding with Gold.

Gold may be applied to other substances as a covering, by a metallic mixture as a pigment; or by friction, as with black lead or chalk; or by the chymical precipitation of gold from mercury, or some other solvent; and, lastly, by gluing or fastening gold leaf to the surface intended to be gilt.

Gold Gilding by Friction.

Steep a fine linen rag in a saturated solution of muriate of gold, till it has entirely imbibed the fluid; this rag must then be dried over a fire, and afterwards burnt to tinder. When any thing is to be gilt, it must be previously well burnished; a piece of cork is then to be dipped first into a solution of salt in water, and afterwards into the black powder, and the piece, after being rubbed with it, must be burnished. This powder is very suitable for gilding delicate articles of silver.

To Gild Brass or Copper.

Brass may be gilt by dipping it into a solution of muriate of gold, which is free from excess of acid, several times, and then burnishing it.

Water Gilding.

If a solution of gold be copiously diluted with ardent spirits, a piece of polished steel will be gilt by being repeatedly steeped therein.

Steel Gilding.

Pour into a solution of gold with nitro-muriatic acid about twice as much sulphuric ether. This mixture applied to well polished iron or steel with a fine brush or pen, will leave thereon a gilt figure of whatever is drawn; the ether evaporating, will leave the gold on the surface of the iron or steel.

Polished iron or steel may also be gilt in the following manner:—Heat it until it is of a blue colour, and lay on it a piece of gold leaf and burnish it down lightly; then, if more is necessary, heat it again and lay on another leaf; and lastly let it be well burnished. It is common to lay on two or three thicknesses of the gold leaf in this manner for very valuable works.

Gilding of Glass.

This is commonly effected by covering the part with a solution of super-saturated borate of soda, and applying gold leaf upon it, which is afterwards fixed by burning.

Edges of Tea-Cups, &c.

Are gilt by applying a very thin coat of amber varnish, upon which gold leaf is to be fixed, and when the varnish is dry the gold must be burnished. To gild wood, the gold leaf is usually laid on a coat of size, or boiled oil, and afterwards burnished

Cupellation.

If gold be alloyed with copper, lead, &c. it is purified by the process called *cupellation*, in the following manner:—The alloyed gold is put with about twice its weight of silver, and some lead, into a crucible made of a very porous substance, such as bone ashes, and called a *cupel* They are all exposed to a considerable heat, which oxidates or converts it into a semi-vitreous oxyde of lead or litharge, enabling it likewise to form a similar kind of substance with the other metals in the alloy.

This glassy fluid soaks into the pores of the cupel, while the remaining mixture of gold and silver is left behind in the vessel. The silver is then separated as follows:—Add to the mixture three times as much silver, and melt the whole together, and then throw on some sulphur. The sulphur will combine with the silver, and the gold will fall to the bottom. This last operation is called *parting* or *quartation*.

Silver.

This metal is found both native and mineralized, and combined with lead, copper, mercury, cobalt, sulphur, arsenic, &c. It is found in different parts of the earth. The mines of Mexico, and Potosi in South America are the most noted; but silver is also found in some parts of Europe, and small quantities of it in some places in the United States. The colour of native silver is white, and often tarnished. Silver when combined with gold is of a yellowish white, and forms what is called the auriferous native silver ore.

Silver is very brilliant and sonorous: it is the most splendid of all metals, and very heavy; its specific gravity being from 10.475 to 11.091 according to the state of its density. It is also exceedingly ductile and tenacious, and may be beat into leaves of only 1-100,000th part of an inch in thickness, and drawn into wire of only 1-1000th part of an inch in diameter.

Method of obtaining Silver.

In Mexico and Peru, the mineral containing the silver, &c. is pounded, roasted, washed, and then triturated with mercury in vessels filled with water. A mill is employed to keep the whole in agitation. The silver combines by these means with the mercury. The alloy thus obtained, is afterwards washed, to separate any foreign matter from it; and then strained and pressed through leather. This being done, heat is applied until the mercury is driven off, leaving the silver behind, which is then melted and cast into bars.

In order to extract silver from sulphurated or vitreous ore, the mineral is to be roasted, and then melted with lead and borax, or some other flux to assist the fusion. By the first operation the sulphur is volatilized, and by the second the silver is obtained, though commonly mixed with alloy of some other metal, from which it is separated by cupellation, or fusion with lead or bismuth.

Silvering.

There are various methods of giving a covering of silver to the surface of bodies. Thus copper may be silvered over by rubbing it with the following powder: Two drachms of acidulous tartrite of pot ash, the same quantity of muriate of soda, and half a drachm of sulphate of alumine, mixed with fifteen or twenty grains of silver, precipitated from nitrate of silver by copper. The copper becomes white when rubbed with this powder, which may afterwards be brushed off, and polished with leather. Or thus: Take half an ounce of silver that has been precipitated from nitrate of silver by the addition of copper, muriate of soda and muriate of ammonia, of each two ounces, and one drachm of muriate of mercury, are triturated together, and made into a paste with water; with this copper utensils of every kind, that have been previously boiled with acidulous tartrite of pot ash, and sulphate of alumine, are rubbed; after which they are made red hot, and then polished.

The dial plates of clocks, the scales of barometers, and other similar articles are silvered by rubbing upon them a mixture of muriate of silver, muriate of soda, and acidulous tartrite of pot ash, and afterwards carefully washing off the saline matter with water. This must be repeated, and the article heated, to make the silvering durable.

Silver Plating.

The covering of copper with silver is performed in the following manner: Upon small ingots of copper,

plates of silver are bound with iron wire, in proportion of about one ounce of silver to twelve of copper. The surface of the silver plate being something smaller than that of the copper; upon the uncovered edge of which a little borax is put, and by exposing the whole to a strong heat, the borax melts, and in melting, contributes towards the fusing of the silver near which it is laid, and to attach it to the copper: The whole is then passed between steel rollers until of a proper thickness to be cut into small pieces for buttons, or such other article as it is intended to form.

Sometimes the plating is not left more than the 1-300th part of an inch thick; but it soon wears off when made so thin.

Copper.

Copper is found in the earth in various states. It is found native *(Virgin Copper)* possessing the red colour, malleability, and many of its other properties; but seldom entirely pure, being generally mixed with a small portion of gold or silver: Its ores are often mixed with sulphur, arsenic, &c. &c. Copper is found in many places in Europe, and in the United States, particularly in New Jersey, and in vast quantities near lake Superior.

Copper is of a rose red colour; sonorous, tenacious, ductile, and malleable. Its specific gravity is from 7 788 to 8.584. It is a good conductor of electricity and galvanism, and mixes freely with some other metals. When mixed with zinc, it forms brass and pinchbeck, and with tin it forms bellmetal, bronze, &c. Copper is poisonous to the human system, especially when taken into the stomach.

Method of obtaining Copper.

Copper is obtained from its ores by different processes, according to the nature of those ores. If they contain much sulphur, after being pounded and washed, they are roasted in the open air, to dispel the sulphur. The ore is afterwards roasted once or twice more, and

is melted in an open fire into a mass, called a mat of copper. In this state it still contains sulphur, which is to be dispelled by repeated roastings, and by fusion, until it acquires a certain degree of purity, and is then called black copper, which is somewhat malleable.

In order to purify it completely from any remainder of sulphur, iron or other mixture, it is hastily fused with three times its weight of lead. The lead unites with the copper, and expels the iron, &c. The copper is afterwards refined by keeping it heated in crucibles for a considerable time, so that it may throw up all the foreign substances in the form of *scoria*. It is examined occasionally by immersing iron rods into it, which become coloured with a small quantity of copper; the purity of which is judged of by the brilliant redness of the specimens on the rods.

Iron.

Of all the metals, there is none which is so copiously and so variously dispersed through nature as iron; nor is there any other metal so generally known and so abundantly useful to mankind. In animals, in vegetables, and in all parts of the mineral kingdom, the presence of iron may be detected. There is a great variety of iron ores enumerated by chemists, and distinguished by names according to their combinations with other substances; but the two kinds most common, and from which iron is generally manufactured, are the *lump* or *kidney* ore, which is well known in western Pennsylvania. It very much resembles the common limestone in outward appearance, being generally covered with yellow oxoid, which becomes red by roasting or burning. This kind of ore contains sulphur, and often a portion of silex. It is sometimes found on the surface of the ground in lumps, but generally at a few feet below the surface, extending in veins, or beds of considerable length, and often running nearly horizontal. Some veins of it are found extending like a band round a hill, or wavey piece of ground in separate lumps, some of them of 100 pounds weight, or more. The other kind is that which is generally used in the northerly part of

New Jersey. It resembles the mineral coal of Pittsburg more than it does the lump ore of Fayette county. It is very rich—some arsenic, sulphur, load stone, or natural magnet, &c. &c. are often found with it. This kind of ore often lies very deep in the earth, running in solid veins like mineral coal, and so hard that the miners are in the habit of boring, and blowing it out with powder. Pure iron is of a whitish grey, or bluish colour. Its specific gravity is from 7.6 7.8. It is very hard and elastic, and so ductile that it may be drawn into wire as fine as human hair.

The common method of obtaining iron from its ores, is first, to roast them to a strong heat, which expels the sulphur, carbonic acid, &c. It is then pounded into small pieces, which are exposed to the intense heat of a furnace, which causes the oxigen to combine with the carbon, forming carbonic acid gass during the process, which reduces the oxoid (or powder) to its metalic state, when it is cast into such a form as is wanted.

To obtain the iron more pure, or to free it from the carbon with which it is combined in this state, it is melted, and kept in fusion for a considerable time, during which it is kneaded and stirred, until the gas is expelled and the metal becomes viscid and stiff: The operation of rollers or a large hammer then forces out most of the remaining oxoid and other impurities, and brings it into the convenient form of bars, &c. for use, but is not yet entirely pure.

To convert Iron into Steel.

Alternate layers of charcoal and bars of iron are laid in a close furnace, and exposed to strong heat for five or six days, or more, after which the fire is extinguished, and the bars left to cool gradually for several days. This forms *blistered steel* It is then hammered into smaller bars, or sometimes fused, and cast into small bars, which are called *cast steel.* The more carbon introduced the more brittle will the steel be. If steel be heated until it is near its fusing point, and then cast quickly into very cold water, it may be made so hard as to scratch glass like a diamond. It is heavier than iron.

To distinguish Steel from Iron.

Drop a little diluted nitric acid upon a bar or plate, and let it remain a few minutes, and then wash it off. If a black spot remains it is steel, but if the spot be whitish grey, it is iron.

Iron, and its properties being so generally known, it is deemed unnecessary to say any thing further on the subject.

Lead.

Lead is found in many parts of the earth. It exists in various forms, but seldom, if ever, in a pure metalic state. The greatest mines of the lead ore known at present are in the new state of Missouri, on the Wisconsin river, and in other parts of the north western parts of the United States.

Lead ore generally contains a small portion of silver. At the mines in Missouri, it is dug up much in the same manner as the lump, or kidney iron ore of Pennsylvania; and to obtain the lead nothing more is required than to break the ore and to expose it to a heat of such a degree as will melt it, and the lead runs down, and is cast into pigs or bolts, pure enough for most uses: but to obtain it pure, it must be dissolved in nitric acid, and the solution decomposed by adding thereto gradually, a solution of sulphate of soda, or sulphuric acid, so long as a precipitate continues to fall. This precipitate must be collected and repeatedly washed in distilled water, and then dried; after which it is to be mixed with two or three times its weight of black flux in a crucible, and exposed to a red heat.

Lead is of a bluish white colour when fresh cut, but soon tarnishes in the air. It is malleable, though not very ductile. Specific gravity 11.435. Lead and tin mixed, form a compound called plumbers solder or pewter, which is more easily fused than either when separate.

Tin.

The native *oxoid of tin* or *tin stone*, occurs both massive and crystalised. Its colour is a dark brown,

sometimes yellowish grey. When crystalised it is somewhat transparent. The *wood tin ore* is a variety of the native oxcid, having a fibrous texture. This variety is found in Cornwall, in England. It is found in fragments, generally round, and of a yellowish brown colour. It is also sometimes found mixed with a little sulphur, with iron and copper. Tin is of a brilliant white colour, resembling silver. It is one of the lightest of metals, its specific gravity being, when hammered, only 7.299. It is very soft, and may be reduced to leaves of 1-100th of an inch thick.

Method of obtaining Tin.

Nothing more is necessary than a mere fusion of the ore with charcoal: but to purify tin it is dissolved in nitric acid with heat. Thus some of the metals it may contain, will be held in solution, others oxidated; but muriatic, or nitro-muriatic acid, or digestion, will take up these, and leave the tin which may afterwards be reduced by mixing it when pulverised with flux formed of equal parts of pitch and borax, and putting it into a covered crucible, lined with charcoal, and heating it strongly for a quarter of an hour.

Tinning Copper Vessels.

The interior surface of the vessel must be scraped very clean, and rubbed over with muriate of ammonia. The vessel is then heated, and a little pitch or rosin thrown into it, and allowed to spread on its surface. Then a little tin is applied over the surface, which instantly assumes a silvery whiteness. This is usually done to prevent the poison of the copper from mixing with the food, or drink which is used in such vessels.

Tinning of Iron.

Pieces of iron are immersed in water, acidolated with sulphuric or muriatic acid, which cleans them entirely from rust, &c. and they are then to be scoured bright and placed in a vessel filled with melted tin,

whose surface is covered with a coat of suet pitch, or rosin, to prevent the surface of the tin being oxidated. The plates of iron being passed through the tin, will, when drawn out, be covered with a thin coat of the tin.

Zinc.

Zinc is found in nature combined with oxigen, carbonic acid, and sulphuric acid, and mineralised by sulphur. It is known by various names according to its combinations with other substances; as, *calamine, vitrious zinc ore*, or *native carbonate of zinc, sulphate of zinc, sulphuret of zinc*, or *blend, &c.*

Zinc is of a whitish colour with a bluish tint, and when broken, its fracture has a crystal like appearance. It is in some degree ductile, and when heated may be flattened between rollers. Its specific gravity is 7 190. It easily unites with several other metals, generally making them more brittle.

To obtain zinc, the ore must be torrified, and mixed with half its weight of charcoal powder, and distilled in an earthen retort three quarters full, (and to which a receiver is luted,) in a strong heat, gradually increased for some hours. The zinc in its metallic form is then found in the neck of the retort. To purify zinc, dissolve it in diluted sulphuric acid, and boil the concentrated solution for a few minutes upon granulated zinc. Then filter it, and precipitate it by soda. Collect and wash the precipitate, and when dry, mix with half its weight of charcoal powder, and submit it to a red heat, in an earthen retort. Pure zinc will then be found in the neck of the retort. Zinc mixed with copper forms brass.

Mercury or Quicksilver.

This muriate is found in five different states in nature.

1. Native mercury in small globules on the surface of cinnabar ores, or sometimes among stones
2. United to silver in the ore, and is then called amalgama of silver.

3. Combined with sulphur, and called native cinnabar, or sulphuret of mercury: this is the most common of its combinations.
4. United with muriatic or sulphuric acid, and is then called horse quicksilver.
5. United to oxigen, it constitutes an ore called oxoid of mercury.

In the foregoing forms mercury is found in many parts of the world, as in Spain, China and South America.

Mercury is the only metal that remains fluid at the ordinary temperature of the atmosphere, in which it has the appearance of melted lead, but at a reduced temperature (about 40° of Fah.) it assumes a solid form, and is then ductile and malleable, and is less in volume than when fluid. Mercury is a very good conductor of electricity and galvanism. Its specific gravity is about 13. 563. It is divisible into very small globules, and at about 600° of Fahrenheit it is volatilized. It is capable of mixing with various other metals making them generally soft, or brittle when the proportion of mercury is large.

Method of obtaining Mercury.

Reduce two parts of cinnabar (red sulphuret of mercury) to a powder, and mix one part of iron filings; put the mixture into a stone retort and direct the neck of it into a bottle, or receiver filled water, and apply heat until the retort is red hot. The mercury will then be obtained in a state of purity.

Tellurium

Is a new metal lately discovered. It is generally found with ore which contains gold. It is of a whitish colour like tin, inclining to a grey, with a texture lamelated like antimony. It is one of the most fusible of metals, melting as easily as tin, and when volatilized emits an odour like that of radishes. Specific gravity, 6 115.

Tellurium is obtained in the following manner:

Mix the oxoid of tellurium into a paste with a little linseed oil, and put into a crucible or small glass retorts

As the oil becomes decomposed, brilliant metalic drops will collect in the upper part of the vessel.

Antimony.

Antimony is seldom found in its native state, but is then of a metalic lustre, and found in masses or lumps of various sizes, of a colour between that of tin and silver. It is also found in the state of an oxoid or *antimonial ochre*, but most commonly combined with sulphur (the grey ore, or sulphuret of antimony) in which state it is of a bluish or steel grey colour and of a beautiful metalic lustre. Specific gravity 5.702. When obtained from its ores it is brittle, and so hard that it will scratch most other metals, and by fusion will unite with them (except with mercury,) making them brittle.

To obtain Antimony.

Heat 32 parts of iron filings to redness, and project on them by degrees 100 parts of antimony, (the ore,) and when the whole is in fusion, throw on it by degrees 20 parts of nitrate of potash, and after a few minutes quiet fusion, pour it into an iron melting cone previously warmed and greased; or,

Melt 8 parts antimonial ore with 6 parts nitrate of potash and 3 of acidulous tartrite of potash, gradually projected into a red hot crucible, and fuse it.

For some uses antimony needs a further purification after the above process.

This metal is one of the principal ingredients used in casting printing types.

Bismuth.

Bismuth is often found in its native state, in solid masses, and also in small particles among stones, &c. It is sometimes combined with oxigen (called oxoid of bismuth or bismuth ore) of a bluish or yellowish grey colour. It has also been found combined with sulphur and arsenic. When obtained it is of a silver white inclining to red, and easily tarnishes; is brittle, and soft enough to be cut with a knife, and fuses or melts almost

as easily as tin. Specific gravity 9.800. To obtain it, fuse the ore with an eighth part of white flux in a closed vessel. It is then purified as follows: Powder, and dissolve it in pure nitric acid, and precipitate it by adding water to the solution. Collect the precipitate on a filter, form it into a paste with oil, and fuse it rapidly with black flux in a closed crucible.

Manganese.

This metal is found mixed with many other substances, and its ores are very common, but always in the form of an oxoid, varying in the degree of oxidation. Its combinations have generally an earthy texture, of a blackish, brown, or grey colour, and will soil the fingers like soot.

When obtained, manganese is of a whitish grey colour, its fracture rough and uneven and of a metalic brilliancy, but soon tarnishes in the air. Specific gravity 6 850. It is hard and very brittle It requires a heat of at least 160° Wedgwood's pyrometer to melt it. It is the most combustible of metals. Its oxidability is so rapid, even in the air only, that it is kept under oil, ardent spirits or water. It has the property of discolouring glass that is tinged with iron, and is therefore used in the manufacture of white or flint glass. It combines readily with some metals, but not with others. It is obtained as follows: Mix the black oxoid (finely powdered) with pitch, making it into a ball, and put into a crucible, with powdered charcoal, 1-10th of an inch thick at the sides and 1-4th of an inch deep at the bottom. The empty space is then to be filled with charcoal powdered fine; a cover to be luted on, and the crucible exposed for an hour to a very strong heat.

Or—digest the black oxoid of manganese repeatedly, with the addition of 1-10th of sugar, in nitric acid; dilute the mixture with three times its bulk of water; filter it, and decompose it by the addition of potash; collect the precipitate, form it into a paste with oil, and put it into a crucible well lined with charcoal. Expose the crucible for at least two hours to the strongest heat of a forge.

Or—prepare a saturated solution of sulphate of manganese; bring it to a boiling heat, and add to it gradually a solution of tartrite of potash, until no further precipitate ensues; then filter the solution and wash the precipitate in water, and when dry, make it into a paste with oil, and proceed as above.

Nickel.

This metal is sometimes found in a metalic state, and in form of an oxoid, generally combined with some other metalic substance, as arsenic, sulphuret of iron, cobalt and copper. Its ore is of a coppery red colour, and generally covered with a greenish grey efflorescence.

Nickel, when free from any other substance, is of a pale flesh colour: when fresh broken, has a strong lustre, is fine grained and compact, and can be a little flatted with a hammer like cast iron. Specific gravity, 7.380. It requires a very intense heat to melt it. Long exposure to the air covers it with a greenish oxoid. When heated with borax, it produces glass of a hyacinth colour. It unites with gold, silver and platina, but not with mercury. It is not magnetic, but has this singular property, that a very small alloy of iron will make it as powerfully magnetic as if the whole mass was steel.

To obtain Nickel.

The ore is roasted to expel the arsenic and sulphur, which leaves it in form of an oxoid, which is mixed with three parts of black flux, and put into a crucible, covered with decripitated muriate of soda, and brought to a state of fusion by a very strong heat. A small lump of nickel (when the crucible is broken) will be found in the bottom; this is afterwards purified to clear it entirely from other matter.

Nicolium.

This is a metal generally obtained from nickel or its ores. It resembles that metal in several respects, while

it is entirely different from it in others. Its specific gravity is from 8.55 to 8.60.

Cobalt.

When cobalt is separated from its ore or other matter it is of a steel grey colour. It is not formed pure in nature, but is generally discovered in the state of an oxoid, alloyed with other metals in form of a sulphuret, or combined with an acid. When found in an oxoid it is called *black cobalt ore;* when alloyed with other metals it forms *dull white cobalt ore*, which contains iron, arsenic, &c. with sulphur, it is called *white cobalt ore.* Cobalt has a redish tinge with the grey colour. It is easily broken and pulverized. Specific gravity, 7.700 to 7.800. It requires nearly as strong a heat to fuse it as to fuse cast iron. When united with other metals it renders them rigid and brittle. It unites readily by fusion with platina, gold, iron, nickel, copper and arsenic, but not with silver, lead, bismuth or mercury. It is supposed to be in some degree magnetical, and it colours glass a fine blue.

Method of obtaining Cobalt.

The ore is torrified in the open air, to separate the arsenic and sulphur, which leaves a kind of black oxoid. This oxoid is mixed with three parts of black flux and one of decrepitated muriate of soda and a little resin. A crucible is then filled 2-3 full of the mixture, and exposed to a gentle heat until the resin ceases to burn, when it is raised to a white heat, and kept up until the mixture is entirely fused. When cool, the crucible is broken and the cobalt separated from the blue scoria.

The cobalt in this state is not pure, but contains a small portion of iron.

Uranium.

This is a scarce metal: its ores are of a blackish colour, generally containing iron, sulphur, lead, silex, &c. The metal is of a grey colour on the outside, and pale

brown inside. It is very porous, and so soft that it may be cut with a knife; but more difficult to fuse than even manganese. Specific gravity, 6 400. It combines with a few of the other metals. To obtain *uranium*, the ore is heated to separate the sulphur, and then carefully cleared of impurities, after which it is digested in nitric acid, which dissolves the metallic matter: the solution is then precipitated by a carbonated alkali. This precipitate, or carbonate, (which is yellow,) is then made into a paste with oil, put into a crucible lined with charcoal, and exposed to a violent heat.

Titanium.

This metal is of a redish yellow colour, and crystalline texture, brittle and refractory. Specific gravity 4.2. It is found in form of an oxoid, with iron; also, in an ore of a prismatic appearance, and in some other forms. It is one of the most infusible of metals. To obtain it, the ore or oxoid is mixed with pot ash and melted; and when the mass is cold, it is dissolved in water, which throws down a white precipitate: this is *carbonate* of *titanium*, which is made into a paste with oil, put into a crucible, filled with powdered charcoal and a little alumine. The whole is then to be exposed to a strong heat for several hours, when the titanium will be found in form of a blackish puffed up substance, of a metallic appearance.

Columbium.

This is a newly discovered metal, the properties, &c. of which is but little known at present. It was first discovered in Massachusetts, in an ore of a dark brownish grey, *externally*, and inclining to an iron grey *internally*. The metal consists of an acid combined with a small portion of iron. Specific gravity, 5.918.

Chrome.

This metal is very scarce, and exists in a kind of metallic oxoid. It has been found mixed with iron,

lead, silex and alumine, of a redish, and sometimes of a brown colour. The *metal* is of a whitish colour, inclining to yellow: very hard and brittle. It is obtained by mixing its acid with charcoal in a crucible, and exposing to a strong heat.

Molybdena.

The ore of this metal is scarce. It has been found mineralized by sulphur. It very much resembles black lead or plumbago. It is of a light lead grey colour. It may be cut with a knife. The metal is generally a blackish powder, or friable mass, with little metallic lustre. It combines with some other metals, and is very difficult to fuse. Specific gravity, from 6.600 to 7 500. It is obtained by difficult process; which I shall not describe here, because the nature of the metal is but little known, and therefore unimportant at present.

Tungsten.

This metal is of a steel.grey colour; specific gravity about 17.6 It is one of the hardest of metals; very brittle, and almost as infusible as platina. It is one of the scarce metals, sometimes found united with iron and manganese. Its uses are yet but little known, except the property which it possesses of fixing colours in some substances which the most subtle acid cannot remove.

The method of obtaining tungsten is as yet but very imperfectly understood, even by the most experienced chymists.

Arsenic.

Arsenic is a common metal, found with various other metals, as sulphur, iron, cobalt, antimony, tin, copper, lead, &c. &c. The sulphuret or sulphurized arsenic ore *(orpiment)* is of a yellowish colour, or sometimes redish *(ruby arsenic)* according to the proportion of its component parts. Arsenic is a very brittle, tin-white, or lead-coloured metal, which, by exposure to

the air, becomes dull or black. Its specific gravity is from 5.763 to 8.310, according to its texture. When heated it emits a smell like garlic It combines with various other metals, generally rendering them very brittle. It turns copper white; is a *deadly poison;* and to preserve it in its metallic form it must be covered with water, or rather alcohol. The arsenic of commerce is commonly an oxoid or white powder, which may be reduced to its metallic form as follows: Mix two parts of the powder with one part of black flux, (obtained by detonating 1 part of *nitrate* of potash, with two of acidulous *tartrite* of potash) and put the mixture into a crucible, and cover it with another, which must be luted on with a little clay and sand, and a red heat applied. The oxoid will then be reduced, and found lining the upper crucible, in small crystals of a metallic brilliancy. After this it is further purified by another, and different process.

Tantalium.

This metal exists in a mineral called *Gadolinite*, and also in a species of *tin ore*, or oxoid of tin, and is, in the first case, united with oxoid of *iron*, and *manganese*. It is distinguished from all other metals by being insoluble in any of the acids. It is acted on only by alcalies. It is of a greyish black colour, and when heated by charcoal, it acquires a metallic aspect, and its fracture is brilliant. Specific gravity, 6.500. It is, in some respects, similar to *tin*, *tungsten*, and *titanium*, but differs from them in others. It is a metal but little known; and therefore does not require a more particular notice in this place.

Cerium.

This metal was discovered in Sweden, in a kind of powder called *cerite*, somewhat transparent, and of a flesh colour. When in the mass, the stone is of an irregular form, and its fracture is a little brilliant, with obtuse edges. It is capable of being turned to a powder, or oxoid, by heating in a certain manner, and is

then of the colour of brick. Cerium has been obtained in the following manner: Pure cerite was dissolved in nitro-muriatic acid, and after saturating the clear solution with alcali, was precipitated by tartrite of potash; the precipitate well washed, heated and digested in acetous acid, contained the pure cerium.

The metallic globule of cerium is harder and more brittle than cast iron.

Palladium.

Palladium is found in the ores of platina, and resembles that metal very much, only it is of a duller white. It is malleable, and may be drawn into wire of considerable fineness. Specific gravity from 10.972 to 11.482. Its power of conducting caloric is nearly equal to, and in expansion by heat it surpasses that of platina. After fusion it becomes of an ash grey colour, and is harder than iron. Palladium is obtained by dissolving platina ore in nitro-muriatic acid (removing any excess of acid, by evaporation, or by an alcali) and mingling the solution with precipitate of mercury, until no further cloudiness ensues; and leaving it to stand a few minutes; when a yellowish white precipitate will fall down, (called *prussiate of palladium*) which, when heated to redness, will yield about five-tenths per cent. of the ore used, in *pure* palladium.

Rhodium.

This metal is also found in the ore of platina. Its specific gravity is about 11.000. It mixes readily with most other metals. It is a metal as yet but imperfectly known, and somewhat difficult to separate from the platina, palladium, &c. which it contains. It is at first obtained in a black powder, which acquires a metallic lustre with borax, but cannot be fused by the greatest heat without the agency of arsenic, or sulphur. It is not malleable in its common form.

Iridium.

Iridium is found in form of a black powder after working the ore of platina. Its metal is of a white colour, perfectly infusible. It does not combine with arsenic or sulphur; but will combine with lead, copper, silver, gold, &c Its ore is harder, and heavier than that of platina, viz: as, 19.5 to 17.7.—The process for obtaining the metal is somewhat difficult, and, perhaps, not of importance sufficient to demand a particular explanation in this work.

Osmium

Also exists in the state of a black powder with platina. It is not acted on by any of the acids. The nature and properties of osmium are too little known at present, to authorise a minute description.

Pewter

Is a compound metal, whose basis is tin. The best pewter consists of tin alloyed with a quantity not exceeding one-twentieth of copper or other metallic bodies, which renders it hard and improves its colour. The inferior sorts of pewter contain much lead, have a blueish colour and are soft.

BRONZING.

BRONZING is colouring by metalline powders, plaster or other busts and figures, in order to make them appear as if cast of copper or other metals.

This is sometimes done by means of cement, and sometimes without, in the instance of plaster figures; but the bronzing is more durable and secure when cement is used. Gold powder and aurum Mosaicum, are frequently employed for this purpose; but the proper bronzing ought to be of a deeper and redder colour, more resembling copper, which effect may be produced by grinding a very small quantity of red lead with these powders:

Or—the proper powder of copper may be used, and may be prepared as follows:—

Take filings of copper, or slips of copper plates, which dissolve in any kind of aqua fortis, and put into a glass receiver, or other proper formed vessel. When the aqua fortis is saturated with the copper, take out all the slips of the plates, or, if filings were used, pour off the solution from what remains undissolved; and put into it small bars of iron, which will precipitate the copper from the aqua fortis in a powder of the proper appearance and colour of copper; pour off the water then from the powder, and wash it clean from the salts by several successive quantities of fresh water.

The true gold powder may be well and easily made by the following method:—

Take any quantity of leaf gold and grind it with virgin honey on a stone, till the texture of the leaves be perfectly broken, and their parts divided to the minutest degree; then take the mixture of gold and honey off the stone, and put it into a china or other bason with water; then stir it well about that the honey may be melted, and the gold by that means freed from it. Let the bason afterwards stand at rest till the gold be subsided, and when it is so, pour off the water from

it, adding fresh quantities till the honey be entirely washed away; after which the gold may be put on paper and dried for use.

The aurum mosaicum, which is tin-coloured, and rendered of a flaky or pulverine texture by a chymical process, so as greatly to resemble gold powder, is prepared in the following manner:—

Take of tin one pound, of flour of sulphur seven ounces, and of sal ammoniac and purified quick silver, each half a pound. Melt the tin, and add the quick silver to it in that state; and when the mixture is become cold, powder it, and grind it with the sal ammoniac and sulphur till the whole be thoroughly commixed; calcine them then in a matrass, and the other ingredients subliming, the tin will be converted into the aurum mosaicum, and will be found in the bottom of the glass like a mass of bright flaky gold powder; but if any black or discoloured parts appear in it, they must be carefully picked or cut out.

Where the appearance of brass is designed, the gold powders or aurum mosaicum may be mixed with a little of the powder called argentum musivum; the preparation of which is treated of under the article *Silvering*. Where the appearance of silver is wanted, the argentum musivum is the best and cheapest method, particularly as it will hold its colour much longer than the true silver used in either leaf or powder.

Where no cement is used in bronzing, the powder must be rubbed on the subject intended to be bronzed by means of a piece of soft leather, or fine linen rag, till the whole surface be covered or coloured.

The former method of using cement in bronzing was to mix the powders with strong gum water or isinglass, and then with a brush or pencil lay them on the subject; but at present some use the japanner's gold size, and proceed in all respects in the same manner as in gilding with the powders in other cases, for which ample directions will be given.

This is the best method hitherto practised, for the japanner's gold size binds the powders to the ground, without the hazard of peeling or falling off, which is liable to happen when gum water, glovers, or isinglass

sizes are used; though notwithstanding the authority of the old practice to the contrary, even these cements will much better secure them when they are laid on the ground, and the effect particularly of the aurum mosaicum, will be much better in this way than the other, the gold size should be suffered in this case to approach much nearer to dryness than is proper in the case of gilding with leaf gold, as the powders would otherwise be rubbed against it in the laying on.

The fictitious powder, called argentum musivum, may as above mentioned, be applied in the manner of bronze, by those whose caprice disposes them to silver figures or busts; but it is the only kind of silver powder that should be used in this way for the reason above given, and all such kind of silvering is better omitted, for the whiteness itself of plaster figures or busts, and much more a shining whiteness is injurious to them or to their right effect, by its eluding the judgment of the eye with respect to the proper form and proportion of the parts from the false and pointed reflexions of the lights and the too feint force of the shades, to remove which inconvenience it is probable was the first inducement to bronzing.

LACQUERING.

LACQUERING is the laying either coloured or transparent varnish on metals in order to produce a different colour, and to preserve the metal from rust or the effects of the weather—thus, glass is made of the colour of gold, and tin is made to resemble yellow metals, &c.

The principal ingredient for the best lacquer is sud lac; but a cheaper kind is made with resin, turpentine, &c.

Receipt to make a lacquer which will give Brass the colour of Gold.

Take of turmeric one ounce and of saffron and Spanish annatto, each two drachms. Put them into a bottle, with a pint of highly rectified spirits of wine, and place it in a moderate heat, shaking it often for several days, when a very strong yellow tincture will be formed, which must be strained through a coarse linen cloth, and put again into the bottle; then add three ounces of good sud lac, coarsely powdered; place the bottle again in a moderate heat, and shake it as before, until the sud lac is dissolved; after which it must be again strained, put into a bottle, and well corked for use. By *adding* to the quantity of *annatto*, the colour will be of a warmer or redder colour, and by *diminishing* its quantity the lacquer will be of a yellower colour, according to the quantity added or deducted. But without the annatto proceed as follows:—

To make a cheaper kind of Lacquer.

Take of turmeric root, ground, one ounce, best dragon's blood half a drachm: put them in a pint of spirits of wine and proceed as above. This is but little inferior to the first; and if the quantity of dragon's blood be diminished, the varnish will be of a redder or truer yellow colour.

A Lacquer for Tin to imitate Yellow Metal.

Take of turmeric root one ounce, dragon's blood two drachms, spirits of wine one pint, and a sufficient quantity of sud lac.

A Lacquer for Locks, &c.

Sud lac varnish alone, or with a little dragon's blood; or a compound varnish of equal parts of sud lac and resin, either with or without the dragon's blood, according as the colour wanted.

A Gold-coloured Lacquer for Leather, &c.

Take of fine white resin four pounds and a half, of common resin same quantity, of gum sandarac two pounds and a half, and of aloes two pounds: mix them together, (after bruising those which are large or coarse,) and put them into an earthen pot, over a good fire where there is no flame. Melt the ingredients well, stirring them that they may be well mixed and may not stick to the bottom of the pot. When well melted and mixed, add gradually to them seven pints of linseed oil, and stir it well while the whole is boiling to prevent it sticking to the vessel. When it has boiled nearly enough, add gradually half an ounce of litharge or half an ounce of red lead, and when they are dissolved strain the whole through a linen or flannel cloth. It generally requires six or eight hours to complete the varnish; and to know when it is done take a little of it from the vessel, and if it is sufficiently boiled it will appear ropy, will stick to the fingers and dry on them. It must be boiled until it acquires these qualities.

Method of laying on the Lacquer.

The metal to be lacquered must be made perfectly clean and bright, and then made nearly as hot as the hand can bear it, by a clear fire or in a suitable vessel, and the lacquer then laid on with a brush as other varnish, and the article warmed again until the lacquer is

thoroughly dry; after which, for fine work, the operation is repeated until the coating is as thick on the metal as is desired.

NOTE.—*It is sometimes necessary to clean the metal with aqua fortis.*

JAPANNING.

JAPANNING is the art of varnishing and painting colours, or ornaments on various substances; as, wood, metals, leather, paper, &c. &c.

In order to prepare the article for japanning, the surface after being made smooth, is sometimes covered with some kind of size or paste to fill up the pores and make the ground even: this method is the cheaper, as it requires less varnish to ornament the surface which has been "primed," than that which has not; but this method is not used by the best workmen, as it is less durable than that which is laid on without the priming.

Wood, or metals do not require any other preparation than that of making their surface entirely smooth; but leather should be strained very tight in a frame, and paper rendered stiff and hard by a coat of some kind of size after being streined tight. Paper is, however, seldom japanned until it is converted into the stiff form in which the French call it "*papier mache*." The priming for japan work should be of a consistency between the common kind of paste and glue, and mixed with so much whiting as will give it a body sufficient to hide the surface upon which it is laid, but no more. The coatings, or primings must be repeated till the surface is entirely smooth, or the inequalities filled up, and then the work cleaned off with dutch rushes, and polished with a wet rag.

A Coarse Varnish for Leather or Paper.

Take 1 pint rectified spirits of wine, coarse sud lac and resin, each two ounces, and dissolve them in the spirit; then strain it well. This varnish should be laid on warm, and the article varnished kept warm; as either cold or dampness chills the varnish, and prevents it from taking proper hold on the paper or leather.

As metals never require to be undercoated with whiting, they may be treated in the same manner as wood or leather.

The colours used with the shell lac varnish, may be any pigment which will give the tint to the ground desired.

Of White Japan Ground.

The method of making a *perfectly white* japan ground, is not yet publicly known; but the method of making the best imitation of a *perfect white*, is as follows:—Take of flake white, or white lead washed over and ground up with one-sixth of its weight of starch, and then dried, and temper it properly for spreading with mastich varnish. After this is laid on the body to be japanned, it is to have five or six coats of the following varnish: Take two ounces of the clearest and whitest grains of good sud lac, and of gum animi three ounces, and dissolve them in a quart of spirits of wine, then strain off the clear varnish.

Blue Japan Grounds.

Blue japan grounds are formed of light Prussian blue, or verditer, glazed over by Prussian blue or smalt. The colours to be mixed with shell lac varnish, and brought to a polishing state by five or six coats of varnish of sud lac. This will however be more liable to give the colour a greenish cast than the varnish above, which is directed for the white grounds.

Red Japan Grounds.

For scarlet coloured grounds, vermilion may be used; but is not so beautiful as that of crimson produced by glazing it over with carmine or fine lake, or even with rose pink. For a very fine bright crimson, Indian lake should be used, dissolved in the spirit of which the varnish is compounded; and in this case, instead of glazing with the shell lac varnish, the upper coats need only be used, as they will equally receive and convey the tinge of the Indian lake, which may be dissolved by spirits of wine, and this will be cheaper than when the carmine is used. If the highest degree of brightness is required, the white varnish must be used.

Yellow Japan Grounds.

For bright yellow grounds, king's yellow, or turpeth mineral is used, either with or without a mixture of Dutch pink; and the colour may be brightened by laying on a coat of turmeric root dissolved in spirits of wine, and strained off before the sue lac is added to it to form a varnish.

Dutch pink forms a cheap, but not a bright yellow colour, without the king's yellow, or the turpeth mineral.

Green Japan Grounds.

Green japan grounds are produced by mixing king's yellow, or turpeth mineral with Prussian blue.

A cheaper kind is made of a mixture of verdigris with the yellows above or with Dutch pink. But when a very bright green is wanted, crystals of verdigris or distilled verdigris should be used and laid on a ground of leaf gold, which renders the colour extremely brilliant.

Orange Japan Grounds

Are formed by mixing vermilion or red lead with king's yellow or Dutch pink; or the orange lake, which will produce a brighter orange ground than can be made of any mixture.

Purple Japan Grounds

Are produced by mixing Prussian blue and lake, or a less valuable kind of vermilion and Prussian blue — They may be treated as the others with respect to the varnish.

Black Japan Grounds

Are formed of ivory black, or lamp black, laid on with shell lac varnish, and their upper or polishing coats of sud lac varnish.

Iron or copper is covered with a black ground as follows: Paint its surface over with drying oil and a little lamp black, and when of a moderate dryness expose it in a stove to a regular heat, such as will turn the oil black, but not so hot as to burn or blister it. If the stove is but little warm when the article is put in, and then slowly increased, and kept at the proper degree of heat for a long time, the ground will become very firm and hard, and need no polishing.

Fine Tortoise Shell Ground, by Heat.

Take of good linseed oil one gallon, of umbel half a pound: boil them together till the oil becomes very brown and thick; strain it through coarse cloth, and set it on again to boil, until it acquires a pitchy consistence, when it will be fit for use.

To lay on this varnish, first clean well the iron or copper plate, to be japanned, and then lay vermilion, tempered with shell lac varnish, or with drying oil diluted with oil of turpentine, very thinly on the places intended to imitate the more transparent parts of the tortoise shell.

When the vermilion is dry, brush over the whole with black varnish, duly tempered with oil of turpentine, to a proper consistence, and when it is set and firm, put the work in a stove, and give it a strong heat for a considerable time—the longer the better, if it were a *month* or more.

This is the method used in England for japanning those elegant articles of tea ware which are brought from Birmingham. This ground is sometimes decorated by painting of various colours, especially on the borders of the article, and then giving it another and a more gentle heating.

Painting Japan Work.

This ought to be done with colours in varnish; but for the sake of dispatch in fine work, the colours are commonly tempered with oil, in which one fourth part of gum animi has been dissolved; or gum sandarac or

gum mastic will answer, if the other cannot be obtained. If the oil be diluted with oil of turpentine, it will lay on the evener, and fewer of the outer coats of varnish will be required.

In some cases water colours are mixed with isinglass size or sugarcandy, and laid on as other paints should be.

Manner of Varnishing Japan Work after it is painted, or on a plain ground without ornament.

This is in general done best with common sud lac varnish; but where brightness is a material point, some of the whiter or more transparent gums must be used, as the sud lac has a tendency to give a yellow tinge. If a considerable degree of tenacity and hardness is essential, at least a part of sud lac should enter into the composition of the varnish, using only the whitest or clearest lumps. The varnish in most esteem is made as follows:

Take of sud lac three ounces, and wash it repeatedly in water to clear it from sticks, &c. Dry it and powder it coarsely, and then put it into a pint of rectified spirit of wine in a bottle which will hold at least three pints. Shake the bottle occasionally, and keep it warm until the lac be dissolved; then pour and strain it off through a coarse cloth, and put it in a bottle which must be well corked for use. If the spirit of wine is very strong it will dissolve a greater portion of the sud lac, but if it be weak it may be rendered of the first degree of strength as follows:

Take a pint of common rectified spirit of wine, and put it into a bottle holding at least three pints, and half an ounce of pearl ashes, salt of tartar, or any other alkaline salt, heated red hot, and powdered as well as may be without injuring it by too much heat, (making it only *red hot.*) Shake the mixture frequently for half an hour, when the phlegm be connected with the undissolved part of the salt at the bottom of the bottle. It must then be poured off from the phlegm, &c. at the bottom, and an ounce of pearl ashes heated, pound-

ed and put into it as before, and treated in the same way. If there is still a quantity of phlegm collects at the bottom, the process must be repeated a third or even a fourth time. An ounce of alum made hot, and put into the bottle, must be suffered to remain there some hours, and frequently shaken, after which the spirit may be poured off, and will be fit for use.

When the varnish is finished, it is laid on in the following manner:

The piece of work to be varnished is held near a fire or placed in a stove room until it is well dryed, and then the varnish is laid on with a proper brush, beginning in the middle and moving the brush towards the end of the article; then from the middle to the other end, &c. The brush should not pass twice over one place in giving the same coat. The article is then again dryed and the coatings repeated until of a sufficient thickness to leave a polish without rubbing bare the paintings or ground colour; the work is then polished with a cloth dipped in tripoli, or rotten stone finely powdered, using a little oil with the stone dust towards the last, and finally oil alone to clear off the dust of the stone, &c. In cases where white grounds are to be polished, instead of the rotten stone use a little fine putty or whiting on the cloth.

ENAMELLING.

ENAMELLING consists in the application of a smooth coating of vitrified or glossy matter, (transparent or opaque; and without colouring, figures, or other ornaments) to a bright, polished metallic substance.

It is therefore a kind of varnish made of glass, and melted upon the substance to which it is applied, and affording a fine uniform ground, for an infinite variety of ornaments, which are also laid on by heat.

The general principles on which enamelling is founded, are, on the whole, very simple, but perhaps there is none of all the *chemico-mechanical* arts, which require for the finer parts, a greater degree of practical skill and dexterity; and of patient and accurate attention to minute process.

Though the term *enamelling*, is usually confined to the ornamental glazing of metallic surfaces, it strictly applies to the glazing of pottery or porcelain; the difference being only, that in the latter the surface is baked clay instead of metal.

The only metals in common use for enamelling are, gold and copper; and with the latter the opaque enamels only are used. When the enamel is transparent and to be coloured, the metal chosen should be of such kind as not only to have its surface unalterable when exposed to a red heat, but also, to be in no degree chemically altered by the close contact of melted glass, containing an abundance of some kind of metallic oxoid. The simplest kind of enamel is that fine white opaque glass which is applied to the dial plates of watches. The process of laying it on, (which may serve as a general example of the art) is as follows: A thin piece of copper is hammered to the proper convexity; cut into the proper size and shape, and a hole drilled through its centre, for the axis of the hands to pass through, and then made perfectly bright with a watch brush. A small rim is then made round the circumference with a thin brass band rising a little above the level, and a similar rim

round the margin of the centre hole. The use of these rims is to confine the enamel when in fusion, and keep the edges of the plate quite smooth and even.

The substance of the enamel is a fine white opaque glass, the materials of which will be presently mentioned. This is bought in the lump by the enamellers, and is first broken with a hammer and then ground to a sufficiently fine powder, with some water in an agate mortar; the superfluous water being then poured off, the pulverized enamel remains like wetted sand, and is spread very evenly over the surface of the copper plate, which must be done with repeated manipulations. The other side of the plate also receives a thinner coat of the same to prevent the plate from springing out of its proper shape when cooling. The whole is then warmed and thoroughly dryed; then gently set upon a thin earthen ring, which touches only the outer edges of the plate, and put gradually into the red hot muffle of the enameller's furnace, and heated until the enamel runs together in a uniform pasty consistence, and extends itself evenly over the surface, shewing a fine polished face, carefully avoiding so great a degree of heat as would endanger the melting of the thin metallic plate.

When the enamel is thus seen to *sweat down* as it were, to a smooth, glossy, uniform glazing, the piece is *gradually* withdrawn from the fire and cooled. It must be *gradual* to prevent the sudden effects of the air from cracking the enamel and causing it to fly off. After this a *second coating* of the *finest powder* of the enamel is put on in the same manner, which makes the plate ready to receive the figures and lines.

These are made of black enamel, ground in an agate mortar to an impalpable powder, worked up with oil of spike or lavender, and laid on with a very fine brush or hair pencil.

The whole is then stoved to evaporate the oil, and the figures burnt in as before: finally, it is polished with tripoli, or sometimes with rotten stone. It may be observed that if the heat is too low, the enamel does not spread and vitrify as it ought to do; if too high, it may melt the metal plate itself, whose fusing point is but little above that of the enamel paste; or, what is

equally injurious, may in a moment melt down, and ruin the delicate figures, &c. which have been laid on with so much care, and consequently spoil the whole work by rendering the face a ridiculous mixture of lines, figures, &c. run together.

The enamel is generally purchased of persons whose business it is to make it. It should be of a clear fine white, of a consistence to run freely in a moderate heat, extend itself with an even glossy surface without melting into a *thin* glass. The following is the method sometimes used to make this kind of enamel:

Mix 100 parts of pure lead with 20 to 25 of the best tin, and bring them to a low red heat in an open vessel. The mixture then burns nearly as rapidly as charcoal, and oxidates very fast Skim off the crusts of oxoid as they form, till the whole is thoroughly calcined. Then mix all the skimmings, and again heat as before till no flame arises from them, and the whole is of an uniform grey colour. Take 100 parts of this oxoid, 100 of sand, and 25 or 30 of common salt, and melt the whole in a moderate heat.

This gives a greyish mass, often porous, and apparently imperfect, but which however runs to a good enamel when afterwards heated.

This is used for *porcelain*, but for metals and finer work the sand is previously calcined in a very strong heat, with one-fourth of its weight, or, if a more fusible compound is wanted, as much of the oxoid of tin and lead as of salt is taken, and the whole melted to a white porous mass. This is then used instead of the rough sand in the above mentioned process. The sand should be of a kind which contains about one-fourth part of *mica*.

Another kind of Enamel.

Calcine 30 parts of lead with 33 of tin, with the precautions before mentioned. Take of this calcined mixture or oxoid 50 pounds, and also 50 pounds of powdered flints, (prepared by being thrown into water when red hot, and then ground to powder,) and eight ounces of salt of tartar: melt the mixture in a strong

heat kept up for ten hours, and then reduce the mass to powder.

This is the common material for opaque enamels, and is of a greyish white colour.

To make a fine white enamel, mix 6 lbs. of this material with 48 grains of the best black oxoid of manganese, and melt it in a clear fire. When fully fused throw it into cold water, then remelt it as before, two or three times, or till the enamel is quite white and fine.

A common Glazing for Delf or White Earthen Ware.

Sixty parts of litharge, 10 parts clay, and 20 of ground flints in a tub of water, brought to about the consistence of cream. When the article is finished, and baked in the form in which it is called biscuit, it is dipped into the above mixture; and when taken out, enough of the mixture is attached to it to give it a very uniform coat of glazing when it has been heated: it is then fixed in the kiln, and at a very moderate heat, it assumes a very glossy and smooth appearance.

The enamel of delf ware may be coloured by adding various metallic oxoids to the composition. The following receipts have been given for that purpose:

1st. *Azure Blue.*—Three ounces of zaffer, and sixty grains of calcined copper added to 6 pounds of the enamel composition.

2d. *Turkish Blue.*—Six pounds of white enamel, three ounces oxidated copper, 98 grains zaffer, and 48 grains of manganese.

3d. *Green.*—Six pounds of white enamel, 3 ounces of oxidated copper, and 60 grains of iron filings.

4th. *Shining Black*, or *Deep Blue.*—Six pounds of white enamel, three ounces zaffer, and three ounces of manganese.

5th *Very Brilliant Black.*—Six pounds of white enamel, six ounces red tartar, and three ounces of manganese.

6th. *Purple.*—Six pounds of white enamel, and three ounces of manganese.

7th. *Yellow.*—Six pounds of white enamel, three ounces of tartar, and 72 grains of manganese.

8th. *Sea Green.*—Six pounds of white enamel, 3 ounces of oxoid of copper, and 60 grains of zaffer.

9th. *Violet* —Six pounds of white enamel, two ounces of manganese, and 48 grains of oxoid of copper.

In all cases the enamel is pounded fine and diluted in water, and the water holding the enamel in suspension, is cast over the vessel: for porcelain or white ware, it is moderately baked before the water, &c is put on it, and then, after being covered with the composition, it receives another and stronger heat to melt the enamel, and fix it to the surface of the ware.

Another kind of Yellow Enamel or substance for Glazing.

Take 112 lbs white lead, 24 lbs. of ground flint, and 6 lbs. of ground flint glass, mixed in water to the consistence of cream. This is sometimes used on queensware.

The enamel, or glazing for common crockery ware, is made principally of the oxoids of lead, and after the ornamental painting is finished and dryed on the article, it is washed over with the liquid glazing, and afterwards baked in a kiln, with such a heat as vitrifies the enamel, and fixes it to the surface.

Under the head of *Glass-Making*, more will be said respecting the various mixtures of earths, &c. &c. which are used as enamels, and for the purposes of glazing, &c.

ENAMEL PAINTING.

THIS differs from all other kinds of painting in the vehicle employed for the colours, (to hold the parts together, and bind them to the ground which they are upon.) This is glass, or a vitrious body, which being mixed with the colours, and fused, or melted *by heat*, until it becomes fluid, and having incorporated with the colours in that state, forms together with them a hard mass when grown cold; it answers, therefore, the same end in this, as oil, gum water, size, or varnish, in the other kinds of painting.

So much having already been said respecting the compounds for the various colours, it is only necessary farther to remark, that by a proper mixture of these colours, a very great variety of intermediate ones may be made.

TEMPERING EDGETOOLS.

TO 2 lbs. of tallow, melted over a slow fire, add 2 drachms of dragon's blood, pulverized fine, while the tallow is warm; then take the vessel from the fire, and stir the mixture till cold. Then, having the tool of a proper heat for tempering, dip it first into this mixture so as to cover the steel, and then put it into clean cold water, or salt and water, and it will neither spring nor crack.

Case-Hardening

Is effected in the following manner—Take of the powder of burnt neat's hoof 2 drachms, soot 1 drachm, salt 2 drachms, old shoe leather 1 drachm, pulverized charcoal 2 drachms, and as much stale urine as will make the whole into a paste, with which the article must be covered pretty thick, and inclosed in a woollen rag. The whole is then to be put into an iron ladle, and held on a clear fire long enough to produce the desired effect, which may be from 15 to 60 or 75 minutes, according to the depth you wish the casing to extend, and then plunge it into pure cold water

When many small articles are to be case-hardened, they may be inclosed in a coat of clay instead of the rag, and then a hole may be made in its side after heating a while, and some small article taken out and plunged in water, by which means you may know whether the heat has been continued long enough or not, an if the article thus tried does not appear hard, the remainder may be a little longer continued on the fire, and then put in water as above.

To temper Cold Chisels to cut Sickle Teeth, &c.

Put 2 drachms of beeswax in a ladle, and when the chisel is brought to a proper heat put it into the wax,

and let it remain till cold; if it prove too hard, reduce it at the fire in the common manner.

To weld Franzy or Brittle Steel.

Take 3 oz. quick lime, 2 oz. bay salt, 2 oz brick dust, 2 oz of glass, 1 drachm of borax: pulverize the whole very fine in an iron mortar, and when the steel is hot rub it in this compound as the smiths do their iron in pounded clay while taking a welding heat.

To soften Steel.

Put it in melted lead and stir it about for 15 or 20 minutes.

To render Iron very soft and white.

Put the iron in the smith's fire as usual, till it is heated to a *straw colour;* then open the fire and put in the bottom of it some dry *horse manure*, (or dung;) lay in the iron and cover it with the same; then draw over the coal again and blow up a pretty brisk fire for fifteen minutes; then cover the fire over with wet manure, blow a few minutes, and then stop the pipe of the bellows with wet tow, and let a l remain in this way for 10 or 12 hours. The iron will then be white, and almost as soft as lead.

Another method of softening Iron, &c.

Take chalk and alum and bruise them together, and while wet with the juice of onions, daub it over the iron or steel a finger thick, and then put it in the fire, and keep it there burning till it becomes clear, and it will be very soft.

To soften Steel or Crystal.

Soak it 24 hours in a ley made of equal parts of unslacked lime and soap-boilers' ashes.

Method of hardening Steel so as not to crack in tempering.

Mix oil of spike and mutton suet together, and when the tool is hot first run the steel part into this mixture, and then plunge it in water.

Another method.

It is said, that if salt petre and copperas, in equal parts, powdered, and strewed over tools when hot enough for tempering, and then plunging them in water in which shell snails have been boiled, will make them of a temper that will cut iron, copper, &c.

Another method.

Mix juice of radishes in ley of wood ashes, and when tools are red hot, it is said this is a proper liquid to harden them in.

A Receipt for Browning Iron, &c.

Five or 6 drops of spirits of nitre, 6 grains of copperas, and 1 pint of rain water; then varnish over with a little sud lac, dissolved in alcohol.

Remark worthy of the attention of Whitesmiths.

If such tools as have the steel laid on one side, such as chisels, &c. be hammered in such a way that the steel side or face of the article be kept next the anvil when hammering, the grain of the steel will be much finer and sounder than if the hammer is used on the face of it.

To keep iron or steel from rusting, without taking away or covering its brightness with browning

Rub over a bright gun barrel, &c. neat's foot oil or the grease of a fried eel, and let it stand an hour or two,

after which rub it off. It will remain bright for a long time.

A new and improved method of Welding Cast Steel to Iron.

Directions and Observations.—Take crude or raw borax, heat it so that it will run like melted cinder or wax, in a clean iron ladle or black lead crucible, pour it on a clean iron plate; when it is cold pulverize it to the consistence of coarse meal, in a clean iron mortar; care should be taken to keep it clean from particles of coal and dust while fusing.

In making an axe, make the head or pole in the usual way, and weld the iron firmly where the steel is to be placed, then, with a thin chisel, split the iron about one inch deep in the middle; then heat the iron that has been split, and hammer it to blunt bevel, so that the iron may be thin on each side of the steel. The chisel should be entered once more to open the iron, which should be nearly white hot; when opened take some of the calcined borax and dash it on along the vacancy; then put your steel in and close your iron gently, so that the steel will keep its place until the welding heat is taken. It may be proper to observe, that the steel is cut or hacked on the part that enters the iron, so as to hold it firm in its place. The axe is put carefully into the fire and laid horizontally, and with clean coals and blown gently until it becomes a bright red; then raise it up and turn it over; the heat should be raised mostly between the edge and the lower part of the steel; care must be taken that the edge of the steel is not so hot as to sparkle, by removing the coals from the edge or corners of the axe. When the iron and steel are brought to a bright red, or so hot that a fluid appears on the surface, and a smoke is seen to rise, it is then in a proper state to hammer; be particular to observe, when the axe is first taken out of the fire, the steel must be driven into the iron by driving the edge of the axe smartly down upon the anvil several times, at the same time holding the tongs perpendicular, so that the steel is well set into the iron; then quickly lay your axe horizontal-

ly, and at that instant bring on your hand hammer and one or two sledges heavily and quickly; then put on a little more of the calcined borax on each side of the axe blade if required, so as to be sure to weld the thin edge of the iron to the steel. For tools where it is necessary to lay the steel only on one side, the calcined borax is applied to the red hot iron, and the steel is placed on cold, held to its place by tongs, then heated and hammered as before mentioned.

Hardening and Tempering.

All tools should be heated slow and regular for hardening, as described for weldings, say a dark red or as low as will take a sufficient degree of hardness. Take one gallon of salt and six gallons of water and temper in.

When an axe or any similar thing is to be hardened, plunge it in nearly under water; then draw it gently out about half way; when sufficiently cold, put it instantly back into the fire for about three seconds, then brighten the steel to see the change of colour.

To reduce the Temper.

For stone augers and mill picks, to a straw colour; for broad axes, scythes, drawing knives, plane irons, turning and cold chisels, to a purple; for ship carpenters' axes, coopers' broad axes, and morticing chisels, between a purple and a blue; for chopping axes, a pale blue or spring temper, heated enough to burn wood; it is then cooled a little at a time with fresh water until cold, to keep the temper the same; soak your tools in running water to prevent them from rusting.

It is said that cast steel marked thus, "*Nailor and Sanders' cast steel, warranted,*" is the best kind that is to be found.

Case-hardening.

Some articles, as gun locks, &c. require the hardness of steel and the toughness of iron at the same time; but

as steel when very hard is brittle, the following process used upon iron will give its surface the hardiness of steel, while the inner parts will remain soft and prevent it breaking:—

Take cow's horn, or hoof, or even old leather, and bake it till thoroughly dried, and then pulverize it; to this add an equal quantity of salt: mix them with chamber ley or vinegar; cover the iron with this mixture, and enclose the whole in loam or a cake of clay, and lay it away till dry; then put it in the fire till of a blood-red heat, and no higher; after which it is to be immersed in water. By this process the surface becomes steel, while the inner parts continue to be iron. The longer the article is continued in the fire, the greater portion of it will be converted into steel; but if it is made too hot, the coating of horn, &c. will be consumed before it has its proper effect upon the iron.

CEMENTS.

1st. EIGHT parts resin and one of wax, melted together and mixed with a little plaster of Paris, is a good cement for stones. The stones should be warm enough to melt the composition, and pressed so close together as to leave but a very thin layer of the cement between them.

2d. Melted brimstone, used in the same manner, makes a tolerable cement, but much weaker than the above.

XX 3d. Jewellers sometimes cement their precious stones together with gum mastic, the stones being previously made warm enough to melt it.

X 4th. Ornaments are fixed on watch cases and trinkets with a cement made with isinglass, soaked in water till it swells up and becomes soft, and then dissolved in French brandy or rum, so as to form a strong glue. Two small bits of gum galbanum or gum ammoniacum are dissolved in two ounces of this by trituration, and five or six bits of mastic, as large as a pea, being dissolved in as much alcohol as will render them fluid, are to be mixed with this by means of a gentle heat. This cement is to be kept in a phial, closely stopped, and when used is to be liquified by immersing the phial in hot water. It will resist moisture.

5th. A solution of shell lac in alcohol, added to a solution of isinglass in proof spirits makes a cement that will resist moisture.

6th. Common glue, melted with half its weight of resin, without water, and a little red ochre added to give it a body, is used to cement hones to their frames, &c.

x 7th. Clay and oxoid of iron, mixed with oil, form a cement that will harden under water.

X x 8th. Cheese of skimmed milk, cut in small bits, (after the rind is peeled off,) and boiled to a strong glue, and the water poured off, is to be washed in cold water, and then kneaded in warm water. This process must be repeated several times, and the glue then put warm

on a levigating stone, and kneaded with quick lime. This cement, if used warm, will join marble, stone or earthen ware, so that the joining can scarcely be seen, and will stand fire or water.

9th. Two ounces of muriate of ammonia, one of flour of sulphur, and sixteen of cast iron filings, well mixed in a mortar, and kept dry. One part of this mixture and twenty of clean iron filings or borings, ground together in a mortar, and mixed with water to a proper consistence, and applied to iron, will unite with it into one solid mass. This is an excellent cement for iron culinary vessels, stoves, &c. &c.

10th. Six parts clay, one of iron filings, and linseed oil sufficient to form a tough paste, is used for stopping cracks in iron boilers.

11th. Beat up the white of eggs very clear, and mix fine powdered lime with it. This is an excellent cement for china or earthen ware.

12th. Boil a piece of white flint glass in river water for five or six minutes, then beat it to a very fine powder, and grind it up with the white of eggs. This is used by the Chinese to mend their ware, and is one of the best kind known for that purpose.

13th. Take equal parts of isinglass, mastic, and turpentine, and beat them up in a stone mortar till they are well mixed. This is a very good cement for China or queensware.

14th. Pieces of amber are joined together by anointing them with linseed oil, and holding them by the fire till they stick, and then set them by to cool and dry.

15th. A putty made of white lead and oil, also makes a pretty good cement for earthen ware. It should be made thin or soft with the oil.

16th. Two pounds of each, litharge and bole, and of yellow ochre and rosin each four ounces, mutton suet five ounces, mastic and turpentine each two ounces, and oil of nuts enough to render the whole of a proper consistency. These all worked together make an excellent cement for damp walls, &c.

CRUCIBLES.

CRUCIBLES are made use of for melting and refining metals; for trying and making colourific ingredients, and for making coloured glass on a small scale. I shall therefore give some of the best compositions for making them.

The Berlin, or Hessian Crucibles,

Are made of one part of good refractory clay, mixed with sand of a middling fineness, from which the finest part has been sifted, that is if the sand is sifted through a No. 16, and then through a No. 26; all the sand that will not pass through 26 is that fit to be used. This admixture of sand with the clay renders the clay leaner and prevents it from cracking while the crucibles are drying.

Another.

Seven ounces of raw clay, 14 ounces of burned clay, sifted through No. 12, and one drachm of calx of vitriol. This mixture is said to stand fire extremely well.

Another.

Eighteen parts burned clay, sifted through No. 12, the same quantity of raw clay, sifted through No. 20, and one part of fusible spar. This must not be exposed to too sudden a heat. These crucibles are capable of being used for melting glass of lead, and can be made more durable by strewing powdered borax over them while they are moist.

Another.

Twenty-four parts of unburnt clay, 4 parts of burned clay, sifted through No. 10, and one part of chalk. This must be armed.

Another.

Ten ounces of unburnt clay, 10 ounces of grossly powdered burned clay, and 3 drachms of calcined sulphat of iron. These crucibles are capable of retaining melted metals, but are pervaded by glass of lead.

Tests for smelting metals are made of burnt bone ashes, sifted through No 8, and the lixivated residuum of wood ashes; there is only enough of the ashes admitted as will give the bone ashes a due degree of tenacity. These tests being porous, the fluxes readily pass through them in all directions, leaving the metal in a perfect button in the test.

Arming crucibles consists in coating them inside with burnt clay diluted with water while they are moist, and, on the outside with unburnt clay diluted in the same manner. This preparation renders them more refractory, and capable of enduring both the action of the fire and corrosion of the fluxes for a much longer period.

Other substances used as glazings on the inside surface of crucibles, have been found to add to their durability, and resist the corrosion of all fluxes except litharge.

Plume alum, powdered and mixed with the white of eggs and water, being applied to the internal surface of a Hessian crucible, renders it capable of containing glass of lead a long time.

One part of clay and two parts of Spanish chalk will make good crucibles.

Eight parts Spanish chalk, as much burnt clay, and one part litharge makes a solid crucible.

Two parts Spanish chalk and one part powdered tobacco pipes makes a good composition for lining crucibles.

Crucibles are rendered very durable by soaking them in linseed oil for two days, then wiping the oil off as clean as possible, and strewing powdered borax or powdered green glass over them. Crucibles should be gradually dried and then tempered by bringing them to a white heat. They should be gradually cooled again,

and should, when put into the oven for tempering, be placed bottom upwards.

The mixture of which crucibles are formed should not be too moist, for if so, when dried and tempered they will not be sufficiently compact; they should therefore be worked as stiff as possible, and made in brass or wooden moulds.

What is herein before given as a composition for crucibles, is only sufficient, in some cases, for one or two; but the proportions can be increased in the same ratio to make as many as you please.

Black Lead Crucibles.

Crucibles intended for the fusion of metals may be much improved by the addition of plumbago. This substance is infusible, and being protected from the action of the air by being coated with clay, its carbonaceous ingredient escapes combustion. It has the additional advantage of having no affinity whatever with the earths, and therefore does not dispose them to fusion. The unctious softness of this material gives a great smoothness to the surface of the crucible, which prevents it from retaining any part of the melted metal when pouring out. The manner of making is the same as that of the Hessian crucible, only adding one-third of the weight of both the clay and sand in the composition.

Crucibles made in this manner will bear a sudden heating or cooling better than any other. It is so soft that it may be cut with a knife or sawed in pieces; but is unfit to retain any saline fluid on account of the porous nature of its surface.

ENGRAVING.

ON COPPER.

ENGRAVING, or *graving*, as it is sometimes called, is the cutting of lines upon a copper-plate, by means of a steel instrument, called a graver, without the use of aqua fortis.

The tools necessary for this art, are, gravers, a scraper, a burnisher, an oil stone, a sand bag, an oil rubber, and some charcoal. The gravers are instruments of tempered steel, fitted into a short wooden handle, and are of two sorts, square, and lozenge shaped: the first is used in cutting very broad strokes, the other for more feint and delicate lines. The scraper is a three-edged tool, used for scraping off the burr raised by the graver. The burnisher is used for rubbing down any lines that are too deep, or for burnishing out any scratches or holes that may be in the copper plate: they are of very hard steel, well rounded and polished.

The oil stone is used for whetting the graver, etching point, &c. The sand-bag, or cushion, is for laying the plate upon, for the conveniency of turning it round in any direction: There is a kind of table sometimes used for this purpose and to which the plate is screwed fast, and so formed that it can be placed in any position to suit the workman's convenience by means of hinges, &c. &c. The oil rubber and charcoal are for polishing the plate when necessary.

Great care is required to whet the graver nicely, particularly the belly of it, and care must be taken to lay the two angles of the graver which are to be held next the plate, flat upon the stone, and rub them steadily till the belly rises gradually above the plate, so as that, when you lay the graver flat upon it, you may just perceive the light under the point, otherwise it will dig into the copper, which will make the work irregular, and injure the point.

In order to whet the face, place the flat part of the handle, in the hollow of the hand, with the belly of the

graver upwards, and rub the extremity upon the stone until it has an extremely sharp point, which you may prove by trying it on the thumb nail. The belly of the graver ought to range nearly with the handle; therefore it is sometimes necessary to cut off that side of the handle till its surface will nearly range in a line with the graver.

The graver may be tempered as follows:—If too hard, heat it on a hot poker, or at a candle, till it is of a straw colour, and then dip the point into cool oil or tallow; if too soft, it must be hardened, and then brought to its proper temper as above directed.

After the copper plate is dressed off and polished smooth, the design of what is to be engraved is laid on in the following manner:—The plate is made warm enough to melt virgin wax, of which a thin coat is laid evenly over it, and the lines, &c of the design-work being traced over with black lead, are laid on the waxed plate and pressed evenly down, or rubbed over with the burnisher, which causes the wax to recover the black lead dust from the design, and to give a good outline of the work, which may be then worked off with the graver, (after tracing through the wax with a sharp pointed tool to mark the plate, and then having taken the wax off) as follows: Hold the handle of the graver in the hollow of your hand, and, extending your fore finger towards the point, let it rest on the back of the graver that you may guide it flat and parallel with the plate, and carefully keep the fingers from getting between the handle and the plate, as that might prevent or hinder the carrying the graver level, and making a clean and smooth stroke.

For straight strokes, the plate is to be held firm on the sand-bag with the left hand, and the right, with the graver, moved regularly forward For circular, or crooked lines, the plate or the hand are moved as may be most convenient, holding the graver firm and steady.

Any roughness which may arise on the work may be taken off with the scraper, being careful not to scratch the plate; and if it is rubbed over with the oil rubber, it will take off the glare of the copper, and then the work will be plainly seen.

To prevent any obstruction from too great a degree of light, a piece of transparent paper is used, placed sloping and at a proper distance between the light and the work—when the sun shines, this is very necessary to preserve the sight.

ON WOOD.

Engraving on wood is a process exactly the reverse of engraving on copper. In the latter, the strokes to be printed are sunk, or cut into the copper, and a rolling-press is used for printing it; but in engraving on wood, all the wood is cut away, except the lines to be printed, which are left standing up like types, and the mode of printing is the same, as that used in letter-press.

The wood used for this purpose, is generally, box-wood, or some other hard, close grained wood; such as dogwood or beech, is sometimes used for coarse work. The wood is first planed very smooth, and the design is then drawn upon the wood itself with black lead, and all the wood is then cut away with gravers, or other proper tools, except the lines that are drawn. In some the design is drawn upon paper, which is then pasted upon the wood, and then cut as before. This kind of engraving answers for cuts, &c. for books; but it is not in general use on account of the difficulty attending the proper execution of the work, and on account of the superiority of the copperplate engraving.

ETCHING.

ETCHING is a manner of engraving on copper, in which the lines, instead of being cut with a graver, are corroded in with aqua fortis.

In almost all the engravings on copper, that are executed in the stroke or line manner, etching and graving are combined, the plate being generally begun by etching and finished with the graver.

The copperplate must be planished off, and then rubbed (all one way) with pumice-stone and water until it is as smooth and level as you can get it; and then finely polished with charcoal and water, which will take out the scratches made by the pumice-stone: finally, with charcoal dust very fine, and a little oil.

Etching points, or needles, are made of steel, about an inch long, and fixed into handles of hard wood, about six inches in length, and of the thickness of a goosequill. They should be well tempered, and fixed accurately in the centre of the end of the handle. They are brought to an accurately conical point. It is necessary to have several etching needles, some aqua fortis, turpentine varnish, bordering wax, and also a pair of compasses and a parallel ruler.

Bordering wax is made as follows: One-third beeswax, & two thirds of pitch, melted & poured into warm water, then moulded until all the water is squeezed out, and then formed into suitable rolls

Etching ground is made as follows: Take of virgin wax and asphaltum, each 20 ounces; of black pitch and Burgundy pitch, each half an ounce: melt the wax and pitch in a new glazed pipkin, and add by degrees the powdered asphaltum. Let it boil until it will break when bent two or three times with the fingers, after being cooled, in the same manner as a shoemaker would try his wax, only this must be dropped on a plate to cool.

When sufficiently boiled, take it off the fire, and after cooling a little, pour it into warm water and work it into balls for use.

To lay on the etching ground, the plate is first wiped perfectly clean, and made just warm enough to melt the ground, and in such manner as not to soil the plate, the etching ground (being enclosed in a bit of taffeta to keep every thing but the pure ground getting to the plate) is rubbed evenly over the surface of the plate until it has received a thin uniform covering of the ground; it is then blackened with the smoke of a wax taper, carefully, so as not to melt the ground in any place, nor to attach any dust to it. The design is then laid on the ground, after it has cooled, in the following manner: A piece of thin paper, rubbed over with red chalk, is laid over the ground, (the chalked side being next the varnish.) The design is drawn on oiled paper with ink containing a little ox gall, which causes it to set on the oiled paper; and this is laid on the chalked paper, and fastened there with a little of the bordering wax. When thus prepared, take a blunt-pointed etching needle and go gently over all the lines of the design, which press the chalked paper on the ground, and thereby transfer the design to the ground, by leaving a tracing of the chalk when the paper is removed. These lines are then traced through the ground to the plate with the etching needles, of sizes suitable to the strength of the lines required. The margin is now bordered round with a ring of the border wax to keep the aqua fortis from running over. After this, the aqua fortis is poured on and allowed to remain on until it corrodes or *bites* sufficiently deep into the plate. If the aqua fortis bites rapidly a great number of small bubbles will arise along the lines; but if it is weak, the bubbles will rise moderately, and then the liquid must remain longer on the plate to complete the operation. If, upon pouring off the aqua fortis, any of the lines should not be corroded deep enough, those which are so must be covered with the turpentine varnish, and the others being left open; aqua fortis must be again poured on, &c. until the whole work is as deep and broad as required. The bubbles as they rise should be brushed off with a feather. After the biting is finished the border wax is removed by heating the plate with a piece of lighted taper applied to the opposite side of the plate. Oil of

turpentine is now poured on the plate, and the plate is rubbed with a linen rag to take off the ground, and then cleaned with whitening.

After this it is common to get a *proof*, taken by a copper plate printer, and if the work is deficient it is finished with the graver or by what is called *re-biting*.

TANNING OF LEATHER.

THE following table contains the respective quantities of tanning matter contained in several kinds of wood and bark (in grains) in half a pint of the infusion, and an ounce of the solution of galls:

Bark of elm,	28	Sallow,	59
Oak in winter,	30	Mountain ash,	60
Horse chesnut,	30	Poplar,	76
Beech,	31	Hazle,	79
Willow [boughs,]	31	Ash,	82
Elder,	41	Spanish chesnut,	98
Plum tree,	58	Smooth oak,	104
Willow [trunk,]	52	Oak, cut in spring,	103
Sycamore,	53	Leicestershire willow,	109
Birch,	54	Sumach,	158
Cherry tree,	59		

Mr. Hatchet recommends the following process for tanning skins. The skins are to be kept separately immersed in running water, till the lymph or serum is extracted, which time may be known by heating a small bit of the skin in water. If it contains serum, this will extract it, and it will rise in a scum on the water; but if no scum arises, the skins may then be considered as cleansed from the lymphatic matter.

These washed skins are then transferred to boilers, adapted for the purpose: water is then added and heat applied to bring the water to about 60 degrees of Fahrenheit, and to remain so one hour.

The skins are then taken out and worked in the usual manner to clear them of their impurities.

After this they are again placed in boilers, so disposed that a constant stream of water at the temperature of 167 degrees of Fahrenheit, shall enter by one cock, and pass off by another at the opposite side beneath.

The skins to remain in this till the water coming off contains no vestige of animal jelly—to be known by evaporating a small quantity of it.

They are then taken out and cleaned in the usual manner of the cellular membrane and fleshy parts.

Lastly, they are to be washed in running water, and replaced in a boiler, and covered with a saturated decoction of tanin or oak bark, the same degree of heat applied and continued till the skins are perfectly tanned, adding occasionally a little fresh decoction to supply the wastage and keep up the principle, which would otherwise become too weak. If it is exhausted it may be known by not turning black when a few drops of a sulphate of iron are added.

New Art of Tanning Leather.

To 40 sides of soal leather, 75 sides of upper leather, or 150 calf skins, take after liming and well worked through the bait to prevent the grain from running, put in half a pound of salt petre; then fill a vat part full of water or enough to cover the hides, then put in one bushel of salt and four lb. of salt petre; this will kill the gum in some measure, the salt petre will penetrate the hides, the most essential thing for soal leather; take one pint of the spirits of salt, put in 4 oz. of the sugar of lead, that will kill the poisonous nature of the spirits of salt, so that the leather will not be injured by it, the spirits of salt will kill the gum and brace the pores and keep them open; then take half a pail full of poke root, dry the same, and leach the strength out with hot water; this will set the liquor to work; when the liquor works skim off the scum, and if there is the least particle of lime left in the hides the liquor will take it out when the liquor works and the above articles in; then put in your hides, 24 hours for calf skins, 48 for upper, 4 days for soal; then take them out and handle them in strong bark liquor: in 48 hours your skins will be tanned, 4 days for upper and 20 days for soal leather will be complete. Remember just before your soal leather comes out of the bark liquor, say 48 hours, put in 2 quarts of spirits terebinth; this will close the flesh and make the leather solid so that it will not give under the hammer.

A New Method of Tanning without Bark.

After your hides have gone through the above mentioned liquors, take 300 lb. of arsemart, cured in the same manner as you would hay, and leach the strength out with hot water; the liquor will come out black as a cherry; and there is more real strength in 500 pounds of this weed than there is in four cords of bark, and will make better upper leather than any kind of bark. This liquor is sufficient salt, salt petre and poke root for upper—for calf skins salt petre, spirits of salt, spirits of terebinth and poke root.

Soal Leather may be Tanned in 30 days by the following process:—

Take good black oak bark, ground as fine as possible; then put it into a hogshead with a hole in the bottom; then fill the hogshead with soft water, and draw it off once a day for thirty days, and handle your hides in the liquor for the time stated and your leather shall be complete.

For Bating Hides in 24 hours—Upper Leather or Calf Skins.

For every 20 calf skins take half a bushel of hen dung, and put it in bating water; put your skins in a barrel; then add a gallon of the above solution, as warm as you can tramp them; then put them in fresh water over night; then work them out. You may tan upper leather and calf skins in from 6 to 8 days, as above directed, for soal leather.

German Method of Blacking Leather without Oil.

Take two ounces logwood, one handful white hazel, 1 ounce nut galls, to one gill of water; put the ingredients into an earthen pot and let them boil to half a gill; then add half a gill of vinegar.

Tawing, Colouring, &c. of Leather.

When skins are to be tawed, they must first be cleaned of the hairs or wool by some proper process, and after being cleaned from lime, &c. they are put into a solution of alum and salt in warm water in proportion of 3 lb. of alum & 4 lb. of salt to 120 common sized sheep or goat skins, and worked therein till they have absorbed a sufficient quantity of the solution. They are then taken out and washed, and put into a vat and allowed to ferment for a time, till most of the alum and salt is taken out and the thickning produced by them reduced; after which they are hung up in a stove room to dry.

After this they must be again soaked in water to take out more of the alum, &c. and then put in a vessel containing yolk of eggs beat up in water and trodden for a long time, and then hung up to dry; after which they are finished by glossing with a warm iron.

German method of Blacking Leather.

The Germans use a solution of iron in vegetable acid, which they rub repeatedly over their leather till it attains a full and beautiful black. It must be observed that this is only used on what is commonly called the grain or hair side of the skin, as the flesh side is generally blacked with oil and lamp black. Copperas is the most usual form in which the iron is used; sometimes filings, scales, or even small pieces of iron are dissolved in a vat of the acid; but it must not be so strong as to act very rapidly upon the iron lest it should render the leather stiff and liable to crack. Vats made in this manner may be kept for hundreds of years by adding a due portion of the ingredients when the liquor becomes too weak. After the leather is blacked in this manner, a gloss is given to it by the common process of brushing over a size made of gum, white of eggs, neat's foot or other suitable material, and a small portion of oil on the flesh side to make it pliable and soft.

Another method of making a fine Black,

Is to put an ounce of ivory black into a pint of small beer, with half an ounce each of brown sugar and gum arabic. This will give a beautiful black, after which a gloss may be put on the leather, made of gum arabic or a size made in vinegar.

There are various methods of giving a black to the grain side of skins, used by the Germans; but perhaps none more simple and convenient than the foregoing.

Red Morocco Leather.

After the skins are cleansed in the usual way, and taken from the lime water, the thickning occasioned thereby is taken down by a bath of dog's or pigeon's dung diffused in water, where they remain till well suppled and the lime is quite got out and they become clean white pelts. They are then sewed up in form of a sack, with the grain side outward (that side only to be coloured) and then immersed in a bath of cochineal, as warm as the hand can bear it, and worked about until they are sufficiently and evenly coloured. The skin sack is then put into a vat containing sumach infused in warm water, and kept there some hours till sufficiently tanned, and finished off after being dipped in a weak bath of saffron water.

Black Morocco Leather.

The skins to be blacked are sumached without dying first, and then brushed over with an iron liquid which combines with the gallic acid of the sumach, forms a deep black. They are then rubbed over with a little oil to supple them, and rubbed with a glass ball of a particular shape to polish them, and finally creased with a piece of boxwood cut for the purpose into small even grooves on its surface.

Chamois Leather

Is generally sheep skin, and made much in the same manner as the foregoing, except that it is finished off with oil, and will therefore bear washing.

For Blacking Leather without Oil.

To black 6 calf skins take 1 pint of soft soap and add sufficient quantity of lamp black to mix it, then add a gill of water and it will make a good black.

For Grain Blacking.

Take one pound of the bark of witch hazel; to that add three gallons of whey, and put them in a rag and let them stand a month in a warm place in the sun.

To make Shell Lac Varnish for Leather.

Take 2 oz. shell lac and 1 oz. Venice turpentine, 1 pint highly rectified spirits of wine: then first dissolve the lac in the wine, which will take two days; then add the turpentine—it will dissolve in one day. Then, if you want black varnish put in a little lamp black.

To make Leather Water-Proof.

Melt 1 lb. of tallow with 4 oz. hog's lard, 2 oz turpentine, and 2 oz beeswax, and put on plentifully while warm and the leather clean and dry. Or,

Of beeswax, Burgundy pitch, and turpentine, each 2 oz. tallow 4 oz. Or,

Beeswax ½ lb. rosin ¼ lb. and beef suet ¼ lb. applied while warm on clean dry boots or shoes.

An excellent Composition to render Leather Water-Proof.

Take 2 gallons linseed oil, 1 do of whale oil. ½ lb of horse grease; mingle them with 4 lb. of finely ground Prussian blue, and 4 lb lamp black, and boil the whole over a strong fire, adding 1 lb. fine ground benzoin gum, previously well mingled with 1 gallon linseed oil, of which one half is to be put in the above when the composition has boiled half an hour, and the other half when the boiling is finished It is sufficiently boiled when it will not fall in drops from any thing that is dipt into it, and when cold is fit for use. This compo-

sition gives the leather a fine black, keeps out the water, and adds to its durability; it will even keep out hot corroding liquors from injuring either leather or woollen cloth.

Blacking, &c. for Boots and Shoes.

Take one part gum that issues from the goat thorn in summer, 4 parts river water, 2 parts neat's foot oil, 2 parts fine ivory black, 2 parts deep blue prepared from iron and copper, and 4 parts brown sugar candy; evaporate the water till the composition is of a consistence to be formed into cakes. This is a good liquid blacking, and may be dissolved in water or vinegar for use.

Frankfort Blacking,

Is made of the lees of wine, burnt in a well closed vessel, and the residuum reduced to powder, and mixed with water, is immediately fit for use.

Another and better kind.

Take $1\frac{1}{2}$ oz. gum arabic, $\frac{1}{2}$ oz. copperas, 2 oz. spirit of salt, 4 oz. ivory black, moistened with $\frac{1}{2}$ oz. of oil of vitriol in $1\frac{1}{2}$ oz. of water: mix them well together, and add 4 oz. sugar candy, $1\frac{1}{2}$ oz. sweet oil, and 3 pints of vinegar. This, shaken well, put over boots, and rubbed with a stiff brush, gives a shining jet black.

Dissolve 1 ounce of glue in a quart of water; add 4 ounces ivory black, 2 or 3 ounces of sugar; mix this with a solution of gum elastic and rosin, prepared with spirit of turpentine and linseed oil.

Wet the leather with a strong decoction of oak bark, and then apply the above composition and let it dry, after which the water will not pass through. Lamp black will answer as a substitute for the ivory black.

One pound hogs lard, 4 ounces turpentine, beeswax, olive oil, 2 ounces each, to be melted and rubbed on the boots the evening before using them, will keep out the water.

In all cases the leather should be made clean before the composition is applied, and also dry or nearly so.

Ivory black, two ounces, brown sugar 1½ ounce, sweet oil, half a spoonful; mix all well, and add half a pint of small beer.

One part gum-tragacanth, 4 parts river water, 2 parts senna soft oil, 2 parts ivory black, 1 part Prussian blue or indigo, in powder, and 4 parts sugar-candy; boil all together, and form into cakes to be dissolved in vinegar.

Black Ball for Boots, &c.

Take mutton suet, 4 ounces, beeswax 1 ounce, sugar-candy and gum-arabic 1 drachm each, in fine powder; melt the whole over a gentle fire and add thereto a spoonful of turpentine, and as much ivory or lamp black, as will give it a good black.

Then have a piece of wood turned in the form you want your balls, and wrap a piece of paper around the stick and push it into damp sand or ashes placed in a box, and when you draw out the stick, it will leave the paper, forming a mould into which you pour the melted mixture before it gets cool, or cast it in tin moulds, made for the purpose, or mould it into cakes when nearly cold.

To clean Boot Tops, Saddles, &c.

Boil 1 quart of milk and let it cool; then take 1 ounce of oil vitriol, 1 oz. spirits of salt, shake them well together, and add 1 ounce red lavender, the white of an egg beat to a froth, and half a pint of vinegar. With this mixture and a sponge, wash the leather over lightly, and let it dry in the shade.

Chemical Liquid for Boot Tops, &c.

Mix in a phial, one drachm of oximuriate of potash with two ounces of distilled, or rain water; and when the salt is dissolved, add two ounces of muriatic acid; then shake well together in another phial 3 ounces rectified spirits of wine with half an ounce of essential oil of lemon. Then unite the contents of the two phials and keep the liquor closely corked for use.

If this is applied with a clean sponge, and the leather dried in a gentle heat, it will remove all stains, and the leather when rubbed or polished over, will look as well as when new.

One pint of drying oil, 2 ounces beeswax, 2 ounces turpentine, and half an ounce of Burgundy pitch, melted slowly, and put plentifully on new boots or shoes, will prevent the water from penetrating the leather.

DISTILLING, &c.

Of making Yeast.

VERY good stock yeast is made as follows—Put one gallon of good barley malt into a clean and well scalded vessel, and pour on 4 gallons of clean scalding water; then stir it well with a clean scalded stick; after which, cover it with a clean cloth for half an hour; then take off the cloth and set it away three or four hours to settle, and when the sediment has fallen to the bottom pour off the thin part that remains on the top carefully, (without disturbing the thick part at the bottom) into a clean scoured iron pot, and add 4 oz. of hops and cover with a clean cover; then set it on a hot fire of coals until it has boiled down one third part or more, and strain it through a clean hair sieve, into a clean glazed earthen crock; then stir into it with a clean stick, as much fine flour as will make it about half thick, and stir until no lumps remain; then cover it close for half an hour, after which, uncover it, and stir it frequently till it is about milk warm only; then add half a pint of very good yeast, and stir it until it is well incorporated, after which it must be covered, and set in a warm place if it be cold winter weather, but in a cool place if it be summer weather. When it begins to work, stir it two or three times at intervals of about half an hour, and set past to work. All extremes of heat or cold must be avoided while keeping, and in summer it is sometimes necessary to set the crock in the spring-house, and nearly to its top in water.

A Substitute for Common Yeast.

Boil 8 pounds of potatoes in common water as if for eating, and mash them fine; then mix with it while warm, two ounces of honey or sugar and one quart of good yeast; this will be sufficient for one gallon. Or, if you boil a handful of hops in three pints of water

till one pint is spent; then strain and cool it, and add a pint of good malt, and mix well with the potatoes, &c. and while yet warm put in half a pint of honey or molasses, and cover it, and let it stand in a warm place. It will be fit for use in five to eight hours, without the quart of yeast as above directed.

Take a small bunch of hops with the thumb and three fingers, and boil them well in a quart of water, put in a few slices of apple or pumpkin; then pour off, and strain the liquor through a cloth and add three spoonsfull of molasses, and stir in as much wheat flour as will make it into batter; then cover it, in a proper temperature, and it will be fit for use in 6 or 8 hours.

Boil two ounces of hops in one gallon of water, to one quart; while hot, strain, and thicken it with rye flour, and when cool add one quart of good yeast, and let it rise for twenty four hours; then mix as much fine Indian meal as will make it into dough, which cut into slices, and lay away to get perfectly dry. This will keep a long time, and should be made in cool weather.

Good yeast thickened with chopped rye, and a little whiskey added, then when dry, rub it into crumbs and put it into a close box or paper bag. This may be kept a long time, and is very convenient for daily use.

Malt.

Barley is the best grain for malting; but wheat and rye are sometimes used in the following manner: —

A proper quantity of the grain is put into a large trough or other vessel, and covered with water until the grain becomes so soft as to be easily mashed between the fingers, when the water is drawn away, and the grain spread on an earthen floor about from one to two feet thick (if the quantity is sufficient) until it begins to sprout, and then spread to about six inches in depth, and often stirred that the sprouting may come on regularly in all the grain In cold weather it is sometimes necessary to cover it with a blanket, and put a little warm water over it by sprinkling, to hasten the sprouting When the sprout (or root) is about as long as the grain, and before the blade appears, it must be

spread thin upon a dry floor to prevent the further progress of the sprouting, and in from 30 to 50 hours it will be fit for the kiln to which it must be removed, and while on the floor, and the fire is under, it must be repeatedly stirred, that it may be completely and evenly dried.

Grinding.

For the purposes of distilling, Indian corn should be ground very fine, but rye, wheat, oats, &c. should not be ground to flour, but to a medium between the choped and the floury degree of fineness.

Mashing.

By mashing is understood the operation of duly mixing the water, meal, yeast, &c. in such manner as to produce a fermentation, and prepare the mixture for distilling in the best form, or so as to produce the greatest quantity of spirituous liquors.

To mash 45 lb. of Corn and 45 lb. of Rye.

Mix 4 gallons of boiling and 4 gallons of cold water in the mashing tub (increasing the proportion of hot water in cold water, or of cold water in warm water) and after a few minutes stir in 45 lb. of Indian meal; cover the tub and let it stand nearly two hours; then add 15 gallons of boiling water, stir it well, and add 12 gallons more of boiling water, (or more if the weather be very cold;) cover it half an hour, and then add 35 lb. of rye meal and 10 lb of malt, and stir it well until all the lumps of meal are broken; then cover the tub for 20 minutes; then uncover it and stir it frequently for 3 or 4 hours in winter and 5 or 6 in summer, when it will be fit to cool off. In winter it should be cooled off with about 25 gallons of returns and as much water as to bring the warmth to about 80 or 90 deg. of Fahrenheit in winter, and 75 deg. in summer; and the tub should be nearly full. To this add one quart of good yeast, and in 50 or 60 hours it will be ready for the still.

Another Rule for Mashing.

Put 10 gallons of boiling water into the mash tub and 40 lb. of Indian meal; stir it well and add two gallons more of boiling water, and stir it; then add 20 gallons more of boiling water and 40 lb. of rye meal, and work or stir it well; then strew over it five pounds of malt meal and cover it for six hours; then cool off with water, adding one quart of yeast, and cover it. In 60 hours it will be fit for the still.

To mash two-thirds Corn and one-third Rye.

The same as when mashing equal parts of each, only using a little more water to soak the corn at first, and the water not raised higher than 160° of Fahrenheit.

Indian Corn alone.

Corn by itself does not ferment well, as it is apt to sink to the bottom of the tub; but the following process may be used:—Put 12 gallons of water (at about 110°) into a hogshead, and add 75 lb. of corn meal; stir it well and let it stand near two hours; then add from 20 to 25 gallons of boiling water; stir it and cover it for half an hour; then add malt and stir it frequently till fit to cool off, which must be done a little warmer than when mixed with other grain, and it also requires a little more yeast.

To 30 gallons of water, at 165 deg. Fahrenheit, add 20 lb. of fine malt; stir it and let it stand 15 minutes; then add 70 lb. of rye meal, and stir until it is well mixed. The mash should then be at about 150 degrees; let it stand from 3 to 4 hours as the weather may require, stirring it occasionally; then add from 20 to 25 gallons of returns which have stood until settled and clear; stir it and fill up with water to reduce it to a proper degree, and then add the yeast. In about 50 to 60 hours it will be ready for the still.

To mash Rye alone.

Two gallons of cold and 4 gallons of boiling water are to be put into the tub, and 1½ bushels of rye meal stirred in; let it stand five minutes; then add two gallons cold water and one gallon malt, and stir it well; let it stand till your water boils, and then add 16 gallons of boiling water; stir it effectually; then put to each hogshead a pint of salt and a shovel full of hot coals out of the furnace, (which will dispel or absorb all sourness, &c. which may be in the tub or the meal) stir it well every fifteen minutes, keeping it covered till scalded sufficiently, when it may be uncovered. If the above quantity of water does not scald it well, more must be added. After the covers are removed, it must be frequently stirred till ready to cool off

It is said that the distillers in Holland use a vessel closed up, except a small hole, over which a kind of valve is fixed, by which means the fine spirit which would evaporate while the fermentation is progressing in the usual way, is nearly all preserved by being condensed, and attaching to the upper part of the vessel and the valve, from whence it drops back into the beer in the vessel; the valve being of such a weight as to raise only when the air in the vessel becomes considerably rarified, when it forces up the valve, finds a vent, and the valve then falls back and closes the opening, until the air again collects sufficient strength to raise it, &c.

The following table shews the proportional quantity of spirits, which, by a due process, may be obtained from several kinds of grain:—

1 bushel of	Rice,	70 lb.	14 to	16 quarts.
	Wheat,	60	12	16
	Rye,	60	12	16
	Corn,	60	12	16
	Barley,	45	7	9
	Oats,	32	6	8
	Buckwheat,	33	5	6

On making Geneva, or Gin.

The common method is to put about 20 pounds of juniper berries to 100 gallons of singlings, and run

them over in the usual method. Either more or less in quantity of the berries may be required according to their goodness; and it is believed that if they could be ground or pounded and mixed with the other materials while mashing, the essence of the berries would be more completely incorporated with the liquor.

Another method of making Gin,

Is to mix oil of juniper berries with the spirits, and if the oil be pure the gin will be very good when it has had time to ripen; but the better way is to mix the oil with pure alcohol, and after it has stood a few days the mixture may be put into proof spirits. Five gills of oil will in this manner make as much gin as 20 pounds of the berries; but the proper quantity in every case can only be known by repeated trials, until the strength of the oil or the berries is accurately known.

Peach and Apple Brandy.

In New Jersey, where this business is carried to great extent, it is customary for all the farmers of a settlement to carry their fruit to one place, where it is made into cider or brandy on certain terms, by persons fully provided with all the necessary apparatus. The usual terms are one barrel of cider or two gallons of brandy for every ten bushels of apples.

Good cider is kept in cisterns or other large vessels until it has undergone the fermenting process, immediately after which it is put into large stills, some of them holding 1000 gallons, and run off as other spirits are. This product is called "cider brandy," and is much better than the "apple brandy," which is made by distilling off the spirit from a mixture of the ground apples and water after it has fermented. Peaches and apples are commonly treated as in the latter method, in this country. Sometimes the cider is distilled, and afterwards water is poured on the pomage and left to ferment, and then stilled off; but this latter process will scarcely produce spirit enough to pay for the labor, &c. of making it.

To know when the cider, &c. has undergone the fermentation completely, run a clean stick into the cask or whatever contains the cider, and if upon taking it out and applying it to your ear, it makes a kind of hissing noise, the fermentation is not over; but if no such noise can be heard, it is ready for the still.

Of Colouring Liquors.

There are various kinds of colouring matter for sale at the shops; but those who do not wish to purchase them, may give their liquors a very good colour in the following manner:—

Burn or parch a handful of wheat, and put it in a barrel of whiskey—or,

Burn or boil down in an iron pot, about a pint of brown sugar, or rather loaf sugar, and put it in a barrel as above—or,

Digest oak shavings in alcohol or spirits of wine, and then put in so much of it as will give the liquor a good colour—or,

Put into a barrel a few handsfull of dried peaches—or,

Digest the shavings of logwood in a small quantity of spirits, which put into the barrel—or,

If the inside of a new barrel be charred or burnt black, it will add much to the flavor, and will also give a good colour to the liquor.

Burnt sugar is made use of for whiskey and new rum.

A pint of burnt wheat will give a barrel of whiskey a very beautiful colour and will improve the flavor.

CORDIALS, &c.

To make Clove Water.

Take 4 pounds of bruised cloves, ½ lb. of alspice, 16 gallons clear proof spirits: digest the whole mixture in a gentle heat, and then draw off 15 gallons by a brisk heat. This may afterwards be coloured and sweetened with refined sugar.

Lemon Water.

Take 4 pounds dried lemon peal, 10½ gallons proof spirits, and 1 do. pure water: draw or distil off 10 gallons as above, &c.

Citron Water.

Take 3 pounds of dry yellow rinds of citron, 2 do. orange peel, ¾ do. bruised nutmegs, 10½ gals. proof spirits, 1 do. water: digest in a moderate heat, draw off ten gallons, and dulcify as above.

Orange Water.

Take 5 pounds fresh orange peel, 10½ gals. proof spirits, 2 do water: digest and draw off ten gallons.

Lavender Water.

Ten gallons rectified spirits of wine, 1 do. water, 14 do. lavender flowers; draw off 10 gallons; which should be done in a water bath.

Compound Lavender, without distilling.

Fill a gallon jug with lavender flowers; then pour the jug full of French brandy on the flowers; cork it up and set in a warm place, or in the sunshine for a month; shaking it often, and then pour it off for use.

Peppermint Water.

Ten gallons proof spirits, 1 do. water, and 14 lbs. dry peppermint leaves: digest and then draw off 10 gallons by moderate heat.

Compound Gentian Water.

Infuse in 6 quarts proof spirts and 1 do water, 8 ounces of leaves and flowers of the lesser centuary, 3 pounds sliced gentian root, 6 ounces of orange peel;

draw off until the fruits begin to rise: this is a preventative against the fever and ague.

Aniseed Water.

Take 3 ounces carroway seeds, 6 do. aniseed; 1 gal. water, 4 do. proof spirit; infuse in the still over night, and then daw off as much as proof will bear, with a slow fire—dulcify with white sugar.

Or thus:—Put two lbs. bruised aniseed in one gallon of water, with 12 gallons of proof spirit; draw off 10 gallons by a slow fire, and dulcify as above.

To make Red Ratafia.

Take 24 lbs. black heart cherries, 4 do. black cherries, 3 do strawberries, 3 do. raspberries; bruise them and let them stand 12 hours; press it out, and put 2 lbs. of sugar for each gallon of the juice. When the sugar is dissolved, strain it and add 3 quarts of proof spirits. Then take 4 ounces of cinnamon, 1 do mace, 2 drachms of cloves; bruise them and put them into the still with 1 gallon proof spirits and 2 quarts of water, and draw off a gallon by a brisk fire: about one quart of this added to the above will make it of an excellent flavor.

To make an Excellent Wine.

X / Take cider fresh from the press, and strain it before it has fermented; then put in as much good honey as will cause it to bear an egg. When it begins to ferment, pour in as much cider as will keep the vessel full, that the filth may work out: when it is done working, bung it up loosely that the vessel may not burs ; in about six weeks add the white of eight or ten eggs, well beat up with a pint of clean sand, (this is sufficient for a barrel) and after mixing them well with the cider, &c. put the whole into a clean vessel and bung it well from October (which is the proper time for making) until April, when it may be racked off into kegs or bottles for use. and will be nearly equal to the best imported wine, although it will not cost above half the price to make it.

There ought to be about one gallon of cider-spirits put into each clean barrel in which it is kept, and on which it is to be poured after mixing the eggs, &c.

A very good cider wine is made by evaporating away, in a broad brewing vessel, about one half of any quantity of fresh cider, and putting the remaining half into a wooden cooler with a little yeast (or into a cask) and fermented in the usual way, &c.

If good cider be exposed to a severe frost, immediately after fermentation, and exposed to the cold until one half is congealed to ice, &c. and the remainder then drawn off into a clean vessel, and closed up well for a few months, it will be nearly equal to the best wine.

To make Currant Wine.

To 14 lbs. of clean, ripe currants add three gallons of water, and mash the fruit well; then stir it once a day for three days; then strain off the liquor, and add 14 lbs. of good sugar (dissolved in a small quantity of the liquor) and let it stand about 14 days, without a bung, after which it may be bunged up tight, adding 1 quart of French brandy to every 10 gallons of the liquor; and about Christmas it may be bottled off for use.

Honey may be substituted for the sugar, putting in a little more in weight, say 15 or 16 pounds.

To make Beer.

Procure a large tub with a false bottom with a number of holes, not large enough to let the malt through; put into it one bushel of malt coarsely ground, and 1 ½ gallons of water (say 7½ gals boiling and 3 gals cold) stir and let it stand three hours; draw it off by a hole at the bottom, and then put on 6 gallons more of water a little warmer than before; stir it, and in two hours draw it off; then 4 gals. more, still hotter, and in one hour draw it off.

Put the two first liquors on to boil, and as they boil down, fill up the kettle with the other liquor, and boil about two or three hours, or till the whole is reduced to 12 gallons; then strain and cool it to 70°, then add a tea-

cup full of good brewers yeast, and as it works over, fill up the tub three times a day for two days and a half, then bung it up and in ten days it will be fit for use: a little of the beer will run over while fermenting; this ought to be saved to fill up with.

Rectification, or Purifying Spirits, &c.

The prime object of rectification is to free the spirit from the essential oil of the article from which it has been distilled.

Many pretended secrets have been spoken of, and even patents taken for supposed discoveries of different processes by which the object might be obtained, which it is not deemed necessary to enumerate; I shall therefore barely state some of the most simple, convenient, and yet effectual methods now known.

If the liquor be run off by a slow and moderate heat, it will contain a much smaller portion of the oil than when a strong heat is applied and the still run off in haste. In this case the oil will remain behind in a great measure, and what does come over is much more easily separated afterwards than when it is completely blended with the spirit by rapid distillation.

If a quantity of pounded charcoal be mixed with the spirits, and the whole put into the still and run off a second time, it will be almost entirely clear of the oil, when it comes over moderately.

In A. D 1803, Dr. Allison of New Jersey obtained a patent for a new method of rectifying or purifying spirits; and as his patent must have expired in 1817, I shall give the process which he recommends.

Procure a barrel or other vessel, with two heads let in one end, about three inches from each other, and the inner head bored full of small holes. Over this place one or two pieces of flannel cloth, cut so as to fit closely around the sides of the vessel. Then procure some clean charcoal, of chesnut or maple; pound it very fine and make a paste of it with some of the liquor to be rectified, and with this paste cover the flannel evenly over, about an inch in thickness; then lay over it a piece of gauze or other thin stuff, and a small light

board on the middle of it to prevent the liquor at first poured in from disturbing the coal. Mix the liquor to be rectified with as much fine coal as will make it as dark nearly as ink, and then pour it gently on the board till you have it so deep as not to agitate the coal paste by the pouring; after which fill up the vessel, and draw off at the bottom by a small hole made in the side between the bottoms. The above is the substance of the process recommended by Dr. Allison, and is perhaps the best now known for rectifying of spirits, as it is nearly pure when it has passed through the coal, which either neutralizes or retains the oil. The same process may be used for cider immediately after pressing off, and the benefit received will amply repay the expense to the lover of good cider. It is said that clean washed sand may be used for cider instead of the charcoal, with very good effect; but it is likely that a mixture of coal and sand would be preferable to the sand alone.

If the business of rectification be carried on in a large scale, it would be necessary to grind the coal, as the pounding would be tedious and expensive.

GLASS MAKING.

IT would not be consistent with the plan and object of this work, to enter very deeply into the history of glass and glass making; but it must be observed, that so far from its being a modern invention, it was known in the days of Aristotle, who flourished 350 years before the Christian era, and who gives two problems upon glass, of which the first is why we see through it? The second, why it is not malleable? In the time of Strabo, who lived in the first century of the Christian era, the manufacture of glass was undoubtedly well understood, and had become a considerable article of trade. Seneca, who lived in the same century, seems not only to have been well acquainted with glass as a transparent substance, but also understood its magnifying powers when formed into a convex shape. Pliny relates the manner of the discovery of glass. It was, he says, first made of sand found in the river Belus, a small stream of Galilee, running from the foot of Mount Carmel. The report of the discovery was, that a Phœnician merchant ship, laden with nitre or mineral alkali, being driven on the coast, and the crew going on shore for provisions, and dressing their victuals upon the sands, made use of some lumps of alkali to support their kettles: hence a vitrification of the sand beneath the fire was produced, which afforded a hint for the manufacture.

As glass cannot be properly manufactured without a furnace and pots made of a particular kind of clay, I shall begin with a description of the various kinds hitherto found fit for the purpose:—

Refractory clay, so called from its long and stubborn resistance to the hottest fire, is of great use to glass manufacturers and others; for, without it, they would never be able to stand the great expense attendant on the frequent renewal of furnaces, &c. Clay for making fire brick pots and glass furnaces, is found in various parts of the world; it is found in great plenty in Ger-

many, France, and England. The best clay is that found at Stourbridge in England, by the side of a bed of coal; it is of a pale blue colour, and pretty hard and heavy, and quite free from any particles of silex or iron. For pots it is ground, finely sifted and mixed without being burned. Pots made of this clay have been known to stand eighteen months in a furnace. For brick they mix half burned clay or pot shells, and half raw clay, and build their furnaces in England with these brick case-hardened.

There are great varieties of refractory clay found in America, and some of them of a very good quality, though there has been none yet found so durable as the Stourbridge clay.

The clay most in use in America is got at New Burlington, on Delaware river; the next at New Castle, in Delaware; the next at South Amboy; and another kind, of inferior quality, on the river Elk, in Maryland — There has lately been discovered a vein of very good clay at Beaver, on the Ohio, and also another at Sewickly, near Pittsburg. The Sewickly clay is interspersed with fibrous roots and iron ore, but when carefully divested of these substances, stands fire exceeding well in pots or brick.

The clay got at Burlington is dug up out of the river at low water. It has a dirty bluish appearance while it is wet; but when dry, looks of a fine pale white, intermixed with red ochre; it is scraped clean from dirt or sand, and freed from the ochre very carefully, at least the part of it intended for making pots. But with respect to the clay intended for brick, the dirt and sand are only scraped off, which is deemed sufficient. After the clay is thus prepared, it is put to dry, and whatever quantity of it is deemed sufficient is ground in its raw state, either by a water or horse mill. Another portion of the clay is put into an oven, and the fire gradually increased from the first to the fourth day; for if the fire is raised too quick, the clay will fly into small pieces. When the fire has been raised to a white heat on the fourth day, keep it so for three days more, making in the whole seven days. After which time the clay will be so well burned that if two pieces of it are struck

against each other they will ring like metal. This clay, thus prepared, is also ground fine in a mill and put by for use. The sieve made use of for the raw clay is from No. 20 to 25; that for burned clay, from No. 16 to 20, if for pots; but if the clay is to be mixed for brick, No. 12 and 16 will be most proper. The old brick of the furnace, &c. are always saved and reground to be mixed with raw clay to make brick; but the broken pots are cleansed from the glass and glazings, and then ground up to be mixed for making pots.

The mixture for brick is 2 bushels of raw clay to 3 bushels of burned, sifted through No. 12 and 16, and a half a bushel of burned brick sifted through No. 10. These proportions are continued till there is a sufficient quantity put into the trough. It is then wet and well mixed; a cloth is then laid over it and then the wooden lid of the trough.

This clay is worked twice a day with a wooden spit, which is made use of to cut it into thin slices, no iron tool being permitted to touch it for the space of ten or fourteen days, and at every time the clay is so turned it is well trodden with clean bare feet, after which time it is fit to mould into brick. The pot clay is mostly mixed after the following manner:—Two bushels and a half of raw clay, sifted through No. 25, to $2\frac{1}{2}$ bushels of burned clay, sifted through No. 16, and a half a bushel of pot shells, sifted through No. 20; then there is a clean cloth put over sieve No. 25, and all the water necessary for moistening the pot ash passed through it. This clay is worked over from 14 to 20 days, after the same manner as the brick clay, after which period it is fit to be made into pots.

Such, in general, is the method of mixing clay for making furnace brick and pots for fusing glass; from which, however, there is a deviation in certain cases, that is, when the clay is either too fat or too poor. What is meant by fat clay is, when it melts or gives way to the action of the fire in a short time. This may also be known by weighing it before it is put into the oven and weighing it after it is taken out. Its silicious properties may be easily ascertained by the difference of weight, especially if after it is burned it has a glazed

surface. In this case the quantity of burned clay must be augmented, and only a sufficient quantity of unburned clay admitted to bind or hold the burned clay together. What is meant by poor clay is, that when there is too great a quantity of pot shells or burned brick admitted into the composition, it loses its tenacity and becomes subject to crack and part asunder. In this case a greater portion of raw clay is added.

New Castle clay is similar in all respects.

Elk clay cannot be relied on, as it is very apt to split from top to bottom in the furnace, and occasions a serious loss of metal, &c.

South Amboy clay is very good, though very rich, on which account it is mixed with as much burned clay as it will bear; though in some manufactories Amboy and New Castle clay are mixed together, for they correct each other, that is, the fatness of the one is corrected by the poverty of the other; but if the Amboy clay is used alone, it will wear away in a short time by the action of the fire, insomuch that the edge and side of the pot next to the fire will be as thin as the edge of a knife, while the part next to the ring stone generally preserves its usual thickness.

Sewickly clay, so called from a creek near Pittsburg, in Pennsylvania, where it is found. It is very impure, having a large quantity of loam, red ochre, and rotten roots mixed with it, from which circumstance it is subject to great waste in separating these substances from it; but when well cleaned it bears fire well, and must be mixed nearly half and half.

Beaver clay, it it could be procured in sizable lumps, is the purest and most refractory clay of any yet found in America, and comes nearest in quality to the Stourbridge clay; but as it is only got in small lumps about the size of a walnut, and sometimes a little larger, it must be wet and made into cakes for burning, which is afterwards ground and mixed with raw clay. There are great varieties of refractory clay in America, but it depends more upon accident than experiment to form a concise judgment of their goodness.

The Zanesville clay answers very well for brick, but it cannot be relied upon for pots, though there are instances where pots have stood some time.

When clay is mixed for making pots, every care must be taken to keep it clean and free from dust, salt, or any other admixture, even the person who treads it must wash his feet clean before he goes into it, and must use a spade of wood to cut down the clay with when it is to be trodden, which ought to be twice a-day for three or four weeks. With respect to the pots, they vary in size according to the size of the furnace, some pots holding from 4 to 6 cwt. and others not quite two hundred weight. Their shapes are also various, except flint glass pots, which are always round and covered at the top with a circular dome, so that though the fire can play round them, none can get in, they having a mouth at the front to put the composition in and gather the glass out of when ready to work. But the pots made use of for green and bottle glass, are some of them round, some oval, and others octagon, and are all something wider at the top than bottom in order that the glass may be got out without difficulty.

Pots are made in moulds in America, France and Germany, and the moulds are always lined with linen cloth to prevent the clay from sticking to them, and also to facilitate the taking off the mould when the pot is finished, in order that it may dry regularly. Some moulds have only temporary cloths attached to them; others have the cloths nailed to them, but in such a manner that they may not come in contact with the clay, as iron rust is very injurious to pot clay. When pots are to be made, the clay is cut up into thin flakes, then beat well together and formed into rolls with the hands. These rolls are cut up again and beat up together again into a form suitable for putting the pot mould over it. It is then worked down to an even surface, and worked out from the centre to the sides of the mould till the bottom is of a proper thickness. This operation forces the clay against the sides of the mould to the height of six inches, where it is firmly placed and guaged; then there are other rolls made, and carefully beat upon, and added to the part already formed,

which is continued till the pot is carried to the requisite height. It is then scraped out and polished, and the mould may be taken off eight or nine hours after the pot is finished. The reason of beating and working the clay so particularly is to make it compact and eradicate the blisters that may be in the clay, as every blister is filled with air, which expands when hot and bursts the pots in which such blisters are.

The pot room should be at least 40 feet long by 30 feet wide, with proper bins and troughs for holding and mixing clay. It ought to be well secured from frost, and have both a stove and a fire place; and the new made pots should be so placed that every part may dry equally, for if one side of a pot dries quicker than another it causes it to crack, and in such cases the pot is rendered useless.

When the pots are perfectly air-dried, or case hardened, they are put into the pot-oven, and gently smoked for 8 or 10 hours; then the fire is gradually raised till the pots are red, when the fire is raised to the highest. The pots are kept in this heat from 20 to 30 hours, when they are taken out of the pot oven and put into the furnace as quick as possible. After the drafts of the furnace are opened, and the pots brought gradually to a proper heat, there is a sufficient quantity of broken glass put into each, which, when properly melted, is gathered on an iron and rubbed round the inside of the pot for the purpose of glazing them; after which they are ready to receive the composition.

If a pot happens to crack in such a part that the furnace can be opened and the air admitted to act upon that part alone, the external air hardens the glass that oozes through the crack, which serves as a plaster and prevents any more glass from passing through. This method of mending is called "concaving," and pots mended in this manner have stood in the furnace from 8 to 10 months in England.

Brick clay is much the same as pot clay, save only that what is not fit to enter into the composition for pots answers very well for brick; it is often also mixed with harsh infusible sand, and sifted through coarser sieves. It is not needful to be so particular in keeping brick

clay clean as it is the pot clay. It can also be made fit for moulding in 14 days.

The moulds are always made suitable to the size of the brick wanted for the furnace and ovens, and are always made with keys, so that when a brick is moulded the keys are taken out, and the mould taken off and dusted with some clay, it is then put together again, and the same process renewed till the required number of brick are moulded The brick must be let dry perfectly, before they are put to burn, for if they are put into the oven without being dry, the moisture contained in them, expands and causes the brick to fly or break to pieces in the oven. Even when they are well dried, forcing the fire too quick has the same effect After the brick are well burned, which will be in the course of twelve or fourteen days, the draft of the oven should be stopped, and the door plastered and the brick let cool gradually, and after the brick are taken out, if any of them have a glossy appearance it should be carefully chipped off, and the brick fitted to its place, before it is bedded in with cement made of the same sort of clay.

Of the Glass-house and the necessary Ovens and Buildings.

The first thing necessary to be observed in building a glass-house, is to have it so situated, that there may be always a free circulation of air through the caves. As soon as the foundation of the glass-house is laid out the situation and extent of the caves, are also laid off and carried up with the foundation In general one long cave running the whole breadth of the house is sufficient in a flint glass house; but such is surrounded with other buildings, or is in an enclosed situation. Other caves, of less magnitude, are formed opening angularly to the eye of the furnace to correct any want of draft in the main cave, and they are usually called cross caves. The cave should be 5½ feet wide in the clear and 6½ feet high, with an open space in the centre, left unarched, of 5 feet. Directly under this opening, and at the bottom of the cave, or equal to the rest

of the foundation, there is a wall bevelling out on each side, ten feet wide at the bottom, and tapering upwards to six feet wide; it is then within two feet of the bottom of the furnace. It must be observed that these two walls that are ten feet wide at the bottom and six feet wide within two feet of the bed of the furnace, though they are five feet and a half apart at the foundation, batter out regularly each way, to come to the width of two feet, at the height of three feet and a half from the floor of the cave, and within two feet of the crown of the cave arch, from which distance, or where the bevel stops, the wall is carried up straight and built with brick, still preserving the distance of two feet between them. When the brick wall is carried up six inches, there are three irons laid in at each side with cramps to them in order to lay them in secure; they are called socket irons, and are placed 14 inches apart on each side. The use of these irons is to lay three bars of iron into them, with three iron rings or shoulders on each, to act as levers in supporting the iron bar and hook used in separating and cleaning the grates of the furnace. When the brick wall is carried up to within five inches of the crown of the cave arch, there are three pieces of half flat iron laid on each end of the wall, that is each way from the centre, so as that there may be an opening in length of three feet long and two feet wide, called the eye of the furnace. Upon the iron bars above stated a flat arch must be thrown to the inside extremity or eye of the furnace, leaving that inside opening or eye three feet long and two feet wide as before stated. On the centre of this opening is placed a cast iron bar, 2 feet 8 inches long, 2 inches thick at bottom, which thickness it bears for an inch on each side, and then bevels for an inch each way, to a point at the top, being something similar in shape to the hip roof of a house, fourteen inches from the centre of this bar each way there is placed one more of the same kind of bars, making three in the whole; their use is to lay the running bars of inch square iron on, which form the grate in the eye of the furnace.

Dimensions of the Siege or Platform of a Flint Glass Furnace, to hold six pots.

The area being a circle, its diameter is 7 feet 6 inches, and as the pillar brick are placed 9 inches in on the siege, it makes the semi-diameter to the inside point of these brick three feet.

This circle is divided into six arches, forming so many openings into the bed of the furnace, 2 feet 8 inches wide outside, and widening to the inside point of the pillar brick to three feet. The height of these six arches is 3 feet six inches each The pillar brick are 16 inches long, 14 inches broad at the outward end next to the cone, and 8 inches broad at the inside, and 8 inches thick Four of these brick are placed on each other before the arches are sprung.

The siege or platform of the furnace ought to be built of fire brick, in three courses of eight inches each, making the siege or platform two feet thick, but in America it is built of a soft sandstone, that does not stand fire long, and must be tempered or brought to a white heat with great care, or else it will be apt to fly to pieces on account of the air and moisture contained in the stone.

The expense of raising and cutting this kind of furnace bed frequently exceeds that of a more lasting one made of clay.

I shall, however, give the size and number of brick fit for the bed or siege of a flint glass furnace: 4 brick, 2½ feet wide, by 3 feet long, and 8 inches thick; 30 brick, 2 feet 3 inches, by 2 feet 9 inches, and 8 inches thick; 3 brick, 2 feet 6 inches, by 2 feet 10 inches, and 5 inches thick; 2 brick, 3 feet long, by 2 feet 4 inches, and 6 inches thick—For each of which, moulds, with keys to them as before described, must be made. I have also given more than the necessary number of brick, in order if any are broke or unfit for use they may be replaced by others.

It is also necessary to cut the outside courses of these brick to fit the outside of the circle of the siege of the furnace, the diameter of which being 7 feet 6 inches,

the circumference will be 23 feet 6¾ inches, and 2 feet thick throughout. The eye or grate of the furnace is 3 feet long and 2 feet wide by 2 feet deep, and the tease hole, by which the coals are admitted into the furnace, is made under the top course of brick, hollow into the eye of the furnace, 12 inches wide and 8 inches high clear through; at the mouth of the tease hole there is placed, directly even with the circle, a cast iron box, 12 inches wide, 14 inches long, and 8 inches high in the clear, with a ledge upon the front edge, all round, 1½ inch broad, in order to stay it in its place. It is called a tease hole frame, and its use is to secure the mouth of the tease hole from injury on account of the coals, rake and poker, the frequent entry of which into the furnace cannot be avoided.

On the bed of the furnace are placed the pillar brick, 4 in each pillar, and 2 feet 6 inches apart. On these pillars are sprung and carried over the semi-arches, forming the six inlets into the furnace, and supporting the dome or crown thereof also. The brick for the semi-arches are 9 inches long, 6 5 8 inches thick at one end, 5 inches thick at the other end, and 5 inches wide, having 9 brick to a course, and rising 1 5 8 inches more at the outside of the arch than the inside. Just where these arches are sprung from the head of the pillar, there is a circular hole left under both the screw backs, and carried out through the depth of the brick, which is 9 inches; the orifice is only 1½ inch in diameter; they are called linet holes, and are made for the purpose of accelerating the draft of the furnace and collecting the fire round the top of the pots.

There are also a number of brick made, called place brick, 12 or 16 inches long, 8 inches wide, and 6 inches deep: there are others, 10 inches long, 4 inches thick, and 6 inches deep: these brick are generally made to build up the mouth of the pot arch with; and when the pots are set, they are then placed before the front of the pots, but in such a manner as to let the fire play round them. The next thing to be observed in building the furnace, is to have it level all round to the heads of the semi-arches, in order that the first course may lie exactly level, for if that course is properly levelled and

set, there will be no difficulty in keeping the other courses regular.

Next follows a description of the rising, length, breadth and bevel of the seven courses of the dome or crown of a flint glass furnace:—

1st course—36 brick for a course, 7 7-8 in thick at the outside, 7 inches at the point, inside, bevel 6 3-8 inches, length 9 inches:

2d course—36 brick for a course, 6 5-8 inches thick at the outside, 6 1 8 inches at the point, thickness at the inside bevel 4 3 4 inches, and 9 inches long:

3d course—5½ inches thick at the outside, 5 1 8 inches at the point, thickness at the inside bevel 3 3-16, and 9 inches long:

4th course—4 4 5 inches thick at the outside, 5 inches thick at the point, thickness at the inside bevel 2¼, and 9 inches long:

5th course—5¾ inches thick at the outside, 4¾ inches rise, and 2 1 8 inches at the point, 9 inches long:

6th course—4¾ inches rise, 2 7 8 inside bevel, 1 7-8 inches at the point, and 9 inches long:

7th course—4 7-8 inches rise, 4½ inside bevel, 2 1-8 inside bevel.

There are seven courses, of thirty six brick each course, each of them growing narrower as they ascend, till the last course leaves an orifice in the centre of 7 inches diameter at the outside, and 5¾ inches at the inside, and 9 inches deep, which is filled by a key-stone, through which there is a hole made, 2 inches in diameter, called the cavilator. Its use is when there is an over-draft of air, or too much fire to carry off the superabundant volume of fire through the centrifugal orifice; and on the contrary, when the current of air is not strong enough, and the fire too slack, the cavilator can be covered by means of a brick kept on the cone for the purpose.

The mortar used in building the furnace should be made of raw and burned clay, mixed with fair water, a little thicker than cream, and a little of it spread under each brick. The brick should be well rubbed in and each jointed as close as possible; and in raising the dome or crown of the furnace, there is no occasion for

centres, as the tenacity of the cement is alone able to support each brick, which, when the course is finished, supports itself, converging in the centre like the spokes of a wagon wheel.

Note, that the outside course or rising involution of the circle, is the back part of the mould, and describes the breadth as well as the height. But the inside or deepning bevel, at the end of the brick describes the inside deepning bevel, depressed or converging similar each way to an egg cut in two, the outside similar to the external form of the dome, and the inside, having the yolk taken out and the white remaining similar to the inside of the dome, if we would suppose the thickness of the shell and white and shell, to bear an analogy to the thickness of the brick in the dome of the furnace.

1st	course	7 7 8	in.	36	brick	9	in. long	6 3 8	in. inside
2d	,,	6 5 8	,,	36	,,	9	,,	4 3 4	,,
3d	,,	5 1 2	,,	36	,,	9	,,	3 3-16	,,
4th	,,	4 5 8	,,	36	,,	9	,,	2 1 4	,,
5th	,,	3 3 4	,,	36	,,	9	,,	2 7 8	,,
6th	,,	2 7-8	,,	36	,,	9	,,	1 7-8	,,
7th	,,	4 7-8	,,	36	,,	9	,,	2 1-8	,,

One cavilator or centre stone, 7 inches diameter at one end, and 6 inches at the other, and 9 inches deep.

Again—

1st	course	7 7-8	inside difference in 9 inches	6 3 8	inch:
2d	,,	6 3 8	,,	4 3-4	,,
3d	,,	4 3-4	,,	3 3-16	,,
4th	,,	5 5 8	,,	2 1-4	,,
5th	,,	3 3-4	,,	2 7-8	,,
6th	,,	2 7 8	,,	1 7-8	,,
7th	,,	4 7 8	,,	2 1 8	,,

		16				16	
7 7-8		14		6 3-8		6	
6 3-8		6		4 3-4		12	
4 3-4		12		3 3-16		3	
5 5 8		10		2 1-4		4	
3 3-4		12		2 7-8		14	
2 7-8		14		1 7-8		14	
4 7-8		14		2 1-8		2	
3 ft. 0 1-8	16	82	5 2-16	1 ft. 11 7-16	16	55	3 7-16

By the foregoing calculation, the rise of the furnace outside from the first course over the semi-arches, is 3 feet and 1 8 of an inch to the top of the cavilator. The inside rise to the bottom or inside point of the cavilator is 1 foot 11 inches and 7-16 or nearly ½ an inch, the difference therefore between the convex of the dome and the concave thereof is 1 foot 0 11-16.

Round the furnace, and against each of its pillars, are built pillars of common brick, 2 feet deep, and 20 inches wide at the base, which taper inwards after the sixth course, forming the base of a cone or circular chimney which surrounds the furnace, and supported by six arches, exactly opposite the arches of the furnace, excepting that arches of the cone are 18 inches higher than those of the furnace, the cone, is carried up tapering till it comes to be three feet in diameter, after which, it is carried up in a straight circular flue, about 5 feet outside the comb of the building.

The pot ovens, for annealing pots should be two in number, their doors, should be in flint glass works, so levelled, that the pot carriage can be run into the oven and under the pot and from thence run into the furnace. Pot ovens are made of various dimensions, some to hold two pots, some four, and others six pots. I shall give the dimensions of one to hold two pots and of another calculated to hold four pots to be tempered or annealed with coals.

The base or floor of an oven to contain 2 pots, should be 9 feet 8 inches in breadth, and 7 feet 9 inches deep, the ash pit should be sunk 20 inches below the floor of the oven, and when even with the floor of the oven, it should be two feet long and twenty inches wide; on this ash pit should be placed two cast iron bars for sleepers to lay the grate bars on; the front wall of the oven should be 9 inches; the side walls 2 feet, and the back wall of the oven 3 feet thick, as the fire place ought to be sloped in under one of the walls, there ought to be an out-jutting flanch wall built to strengthen the side wall where the fire place is built; after deducting the thickness of the walls from the floor of the oven it will be 5 feet deep by 4½ in the clear; the door 3 feet high and 2 feet 4 inches wide; there should be two false jambs or pillars carried up two feet deep and 5 feet apart, with an outward bevel of 3 inches to the foot to support an arch, for running up a shaft thereon; on the back part of this pillar, and directly on the head of the oven, which is 5 feet 9 inches outside, there is a semi-arch, thrown to support the back of the shaft, which batters in till it comes to 20 inches, after which it is carried up straight. The use of the back arch is, that if the head or any part of the oven wants repair the chimney may stand undisturbed.

Dimensions of an Oven to contain 4 Pots.

The floor and side walls are built as before directed, but that this oven on account of its size, ought to have two fire places. It should be six feet wide in the clear, and eight feet deep in the clear, the out walls and shaft to be carried up as before directed.

As there are many glass factories carried on in America with wood, I shall describe a pot oven to suit that mode:—If the oven is for green glass pots, the floor of it may be raised 2 feet from the floor of the house, as the pots are taken out upon large iron bars; but if it is for a flint glass works that wood is used for fuel the floor must be made low enough to run the pot carriage in and the fire place and ash pit equally depressed. The back and side walls of the oven to be heated with wood, are built as before described; the arch into which

the wood is put for heating the oven, is carried from the front of the oven to within 6 inches of the back wall. It ought to be 14 inches wide and 22 inches high, the floor of the flue on a level with the floor of the house; when the flue is run in to about 18 inches of the back part of the oven, it ought to batter back as it rises to meet the floor of the oven 6 inches from the back as before specified; the use of this batter is to give the flame a gradual ascent, and secure the back part of the flue from the damage that may occur from the volume of flame that would, without such precaution, strike against an upright surface, and perhaps in place of ascending through the flue into the oven, may recoil back to the mouth of the flue. The orifice or mouth of the flue on the bed of the oven, ought to be 8 inches long and 6 inches wide, and built round with two courses of brick to prevent any dirt or other impediment from falling in from off the bed of the oven and choaking the flue. The floor of the oven should be 5½ feet wide and 6 feet deep, and if, for green glass pots, 4 feet high; but if for flint glass pots, the crown of the oven should be 5 feet high. The door of the oven for green glass pots should be 2 feet 4 inches wide and 3 feet high. The door of the flint pot oven 2 feet 6 inches wide, and 3 feet 6 inches high.

The oven made use of for tempering or annealing flint glass is called a lear, without which flint glass cannot be tempered or brought to any perfection.

The lear ought to be 40 feet long from its mouth to the lower gates; the bed or floor of the oven or lear about 3 feet high at the front, and 2 feet high at the lower end, making a depressed and gradual level of 2 feet in the space of 40. The bed of the lear should be 7 feet 9 inches, and when the two side walls are built thereon, a foot thick each, it would make the whole ground under the lear 9 feet 9 inches; but the bed of the lear itself as above stated only 7 feet 9 inches in the clear. In the centre of the bed of the lear, should be carried up a nine inch wall, to serve as a partition between both lears; and when this and the two side walls are 14 inches high, there should be centres set and arches cast both ways, from out to centre wall, for the whole

distance; but when the arches are turned for the length of 30 feet, and within 10 feet from the lower gates of the lear, there are two flues left, one on each arch, the purpose of which is to let the smoke and heat out: they are called cooling flues, and are generally terminated in a light shaft. The glass in the lear has the remaining ten feet, have time to cool in its gradual descent, for if it is pushed down too quick it will infallibly crack or fly. At the lear mouth there is two fire places made, each against the side walls, 2 feet 6 inches long, 18 inches wide, and 10 inches high; there are also two bevel pillars, 2 feet deep, to support the breast of the chimney, and a false arch to support the back of it. At the mouth of the lear there is a strong iron frame bedded into the brick work to hang sheet iron gates on, and there is an iron bar laid quite across the mouth of the lear, to save the floor from being ripped up by the continual entrance of the pans, and at every six feet from the outside doors, there are cross pieces of iron laid, to fasten iron bars to that run the whole length of the lear, there are two of these long bars in each lear that the pans may run on them without touching the floor of the lear. At the lower end of the lear there are lifting gates to each lear, to lift up and down when the pans want shifting. The pans are made of strong sheet iron, 18 inches wide, and 2 feet long, so that 19 of them will fill one side; but there ought always to be six spare pans, for fear of any accident; the pans must be strengthened at each end with iron, and each pan must have a cant hook at one end, and a place to receive such another at the other end, so that they may be hooked into one another, and hauled to the bottom of the lear by a winch placed there for the purpose. Shoe, an article made of clay, to heat the pipes in: It is made flat at the bottom, and covered all over by a kind of half circle. It is made on a mould. The mould is 8 inches long, 4½ inches wide, and 3½ inches high, consequently the shoe will be of those dimensions in the clear and ¾ of an inch thick

From the dimensions given of the various kinds of brick wanted for a flint glass furnace, any carpenter can make the necessary moulds without any difficulty.

Of the Green Glass Furnace for Wood or Coals.

My first object is to give a description of the furnance to be heated with wood, as such furnaces are more general in many parts of America, than those carried on with coals, owing chiefly to the difficulty of procuring it, and also the prejudice of certain glass makers, who alledge that the sulphur and smoke of coals, tends to make the glass have a bad colour, but, such inconveniences are not complained of in England, Ireland and Scotland, where all the glass made is fused by means of coals.

Description of the Furnace for Window Glass to contain 12 Pots, each Pot containing 130 Cylinders of 18 by 14, Glass.

The furnace is always erected in the middle of the house, and is what is genera ly termed a French furnace, the outside form of which is an oblong square; but the interior is that of a square or rectangular parallelogram the broadest sides of which are occupied by the pots, which are placed on benches, and only space enough left between them for the fire to play round them.

Thickness of the end walls of the furnace 2 feet 4 inches, till it rises one course over the tease hole arch, where it is contracted to a 16 inch wall, and the scue back on which the arch is sprung is fitted to turn an arch of 1 foot thick.

The length of the benches inside the end walls, and which are to receive 6 pots, each pot 22 inches wide at the top, and an allowance of 1½ inch space between each pot for fire play, is 11 feet 9 inches. The tone or bottom of the furnace is that part whereon the overflowing and overflux of the glass falls, whilst it is melting and is exactly the length of the benches, but is higher by three inches in the centre than at each end, where the benches are 2 feet 4 inches and but 2 feet 1 inch in the centre, making a bevel

each way of 3 inches in 5 feet $10\frac{1}{2}$ inches, half the length of the tone. The use of this bevel each way is to facilitate the drawing out of the hard glass, and as it is extremely corrosive this bevel is made to make it run off towards the hearth, where it is taken out with a rake made for the purpose. Height of the benches from the tone stone 2 feet 4 inches, with the exception of the bevel before stated. Breadth of the tone, or bottom of the furnace, 1 foot 10 inches, and bevelling 2 inches on each side, makes the breadth between the top of the benches, 2 feet 2 inches. Breadth of the benches on which the pots stand, 1 foot 10 inches. Height of the side wall to the edge of the ring stones, 1 foot 10 inches, that is, to within one inch of the bottom of the circle in the ring stone. Opposite each pot, and exactly level with the top of the benches, there is an open space left of 7 inches square, called a foot hole, the use of which is, to accelerate the pot setting, and if the pot is cracked in the sides to turn the part to the foot hole, and concave it as before directed; these holes can be stopped by a brick made for the purpose, called a foot brick and the edges plastered. The ring stones being six on each side, should be 18 inches wide and 14 inches high and 10 inches thick, the outside diameter of the ring or circle in the stone, through which the glass is worked is nine inches, and the inside is flared so as to bring the outside edge to the thickness of $\frac{1}{2}$ an inch, as there are always partition stones between the ring stones, and as these are carried to the breast wall a depth of 14 inches from the pots, and as only 5 are wanted on each side, it will take five partition stones of $5\frac{1}{4}$ inches each, between the ring stones to come to the end walls of the furnace.

As the ring stones are set perfectly level, there is then a course of stone, generally termed table stone, laid which overjut outwards over the ring stones 2 inches, taking care to lay them over the ring stones so as to break joint; these stones are 12 inches wide, 6 inches high and 18 inches long, the whole making the height from the tone stone, to the edge of the scue back, 5 feet 10 inches, and from the level of the benches, to the scue back, 3 feet 6 inches; then the side walls

are built up so as to form an arch over the furnace 11 feet 9 inches long, and as flat as possible in the centre, so as that the fire may not have too much play, but may make the flames reverberate equally over all the pots. The length from the outside edge of the furnace gates to the edge of the benches is 2 feet 4 inches, under which is the ash pit, in the stone or brick, fitted for this part, there is a hole 4 inches square, into which the draft enters from the ash pit, and out of which the ashes fall, this is called a luff hole; but when the hard glass is to be drawn, the coals and ashes are left to accumulate, so that this hole may be full of it, to prevent any of the hard glass from getting in, as it is difficult to get it out.

In the sides of the furnace there are 4 air holes made, 2 on each side, and opening into the furnace exactly where the benches begin, and 10 inches above the tone stone, these air lets are called linnet holes, and at their entrance into the furnace are $2\frac{1}{2}$ inches square, but outside they must be 10 inches by 12, in order that they may be opened or shut occasionally as the draft may require.

The furnace above described, is built upon a platform of common mason work, 2 feet high from the ground, with angular pillars carried up at each corner to support 4 ovens on, which are fed by means of flues from the furnace—they are used to burn sands, ashes, and pot ash in, and in England, Ireland and Scotland, one of them is appropriated for fritting the materials.

The beds of these ovens are generally on a level with the square height of the furnace, that is equal in height to the course from which the scue back starts, these ovens are generally from 5 to 6 feet deep, and from 4 to $4\frac{1}{2}$ feet wide, the flue that communicates with the furnace enters these ovens 10 inches from the floor, their width at the furnace, is 4 by 5 inches, and carried to these ovens by a sloping flue, which at its entrance into the ovens is expanded to 6 by 8 inches, and the gates or door of each oven should be similar in size to the mouth of a common bake oven, and the height of these ovens from the floor to the crown of the arch is 2 feet 6 inches—they are mostly of an oval form inside though somewhat triangular outside.

In some manufactories there are arches cast from the pillars to the tease hole. Their use seems to be to strengthen the backs of the ovens placed on the pillars; but as they are made sloping and compressed towards the tease hole, they are particularly oppressive to the teaser, and much in the way when setting pots. I think them useless, and made only to create unnecessary expense. The gates of the furnace are exactly as wide as the space between the benches, and carry the same flare or bevel, and the arches of them are sprung when the height of the jambs are equal to the height of the benches, and 2 feet 4 inches thick, and a perfect circle. The gate of the furnace is commonly stopped with a shear cake, made of brick clay, the form of which is so universally known that it needs no description, though it is so often subject to be broke, that some have got cast iron gates in place of them.

Number of Brick for a Green Glass Furnace.

28 brick, 24 inches wide, 30 inches long, and 10 inches thick, for gates.

Benches.—12 pieces, 25 inches long, 22 inches broad, and 9½ inches thick—16 pieces, 21 inches long, 22 inches wide, and 9½ inches thick—16 pieces, 22 inches broad, 12 inches long, and 9½ inches thick—16 pieces, 9 inches long, 22 inches wide, 9½ thick.

For sides from Benches up to Arch.

48 pieces, 22 inches broad, 30 inches long and 10 inches thick; 60 brick, 26 inches long, 22 inches broad and 10 inches thick. Ring stones described before.

For Furnace fronts or Tease Hole ends.

60 brick, 18 by 12 inches, and 9½ inches thick.

For Dome or Crown of Furnace.

300 brick, 12 inches wide outside, 6 inches inside, 9 inches thick at the upper end, and 4½ inches thick at the lower end.

But when the benches, tone stone and crown of the furnace are built of sand stone, the mode of building is very different with respect to the size of the bench and arch stone, the arch stone in particular are made with

the necessary bevels and the centres are placed 9 inches lower than the surface of the side walls in both brick and stone crowns. In many places it is the custom to build lump caps or crowns as they are called. They are made in the following manner: The centre is built with its base to answer the base of the furnace; the frame is carried up in a sloping direction to the distance of three and a half feet from the base, each side forming a triangle, whose base is the sides and ends of the furnace, appearing in all respects like the roof of a house, pitched from both sides and ends. When the centre or frame is placed, it is then laid over with tow linen, as smooth and even as possible, and the prepared clay is well beat in all round to the depth of nine inches, which is tried by a guage. After it is finished, if in fine weather, it is left to dry by the action of the atmospheric air for two or three days; but if in moist weather, small fires are made on the pillars and tunnels adapted to the tease hole, 12 or 14 feet long, into which small fires are put to smoke the inside that it may dry equally inside and outside, and a person of judgment appointed night and day to attend and regulate the fires, and also to beat or hammer down the crown or cap with a mallet to prevent cracks, or if there are any, to close them. Before the centre is taken down, or the cap entirely dry, the necessary air-lets or fire vents are cut in the crown, and the linnet holes cut to communicate with the ovens on the pillars. But those kind of caps or crowns are subject to innumerable casualties; for if the clay is not exceeding good, part of it will be constantly dropping into the glass, and is a great interruption to the glass makers; besides, they almost always crack in various parts, and renders or causes the furnace to have an unequal draft, and also very frequently fall in when brought to a white heat.

The only difference between a furnace to be carried on by means of wood, and that carried on by means of coals, is, that the furnace carried on with coals has an air draft by means of four caves, between 6 and 8 feet high, and 6 feet wide: these four caves unite together at right angles at the grate of the furnace, which is in a 12 pot furnace, 11 feet 9 inches long, that is from the

outside edge of one tease hole to the outside edge of the other, and 22 inches wide. Into this space a strong iron frame is firmly bedded, with cross bars at a suitable distance to lay the grate bars on, which are always moveable, and can be taken out and put in at pleasure. The furnace is built above these bars, similar in all respects to the furnace before described, excepting that the grate in this supplies the place of the tone stone mentioned in the other.

The small ovens for tempering green tumblers, pitchers, &c. to go with coals, is built in a similar manner to coal ovens for heating two pots; but it is only three feet high to the crown of the arch, and the door of the oven only 18 by 22 inches. The small ovens, for tempering glass with wood fires, built after the same manner as the pot oven heated with wood; height of arch and doors the same as the small ovens heated with coals. In several glass houses in this country where they use wood, they have frames and a wheelbarrow way, made over the furnace, and a way from the wood yard to wheel the wood up and pile it upon the frames, where the heat from the furnace dries all the sap out, and it then makes a strong and clear reverberating fire. In other glass houses they have ovens which generally hold a cord of wood each, and are so constructed that there is but one fire to every two of them. Four of these ovens dry as much wood as will be consumed in a crown glass house; and if the wood drier is expert and active, in cylinder glass houses he will be able to have a considerable quantity on hand. These ovens should have strong sheet iron dampers, so that if the wood in them got on fire, he could shut the draft and extinguish the fire.

The next ovens to be described, and which is indispensably necessary where cylinder glass is made, are the flatting and cooling ovens. As the glass is blown cylindrical, it could never be flattened were it not for the convenience derived from the aid of flattening and cooling ovens.

The bed or floor of the ovens, and on which the side, centre and end walls are built, is 18 feet 6 inches long, 12 feet wide and 3 feet 6 inches high, of rough mason

work, and in the centre of the flattening end there is an opening left to build a flue, of 16 inches wide, 22 inches high, and 4 feet long, under the flattening stones, so as that the centre of the flattening stone may rest on the centre of the arch of the flue, and the flue to have two openings on each side of the flattening stones, 4 by 6 inches, and carried up from the bottom tunnel in an outside slanting direction, till they come each way 4 inches above the head of the stone, and 6 inches back from it on each side. It must also be observed the opening of the first flue into the flattening oven must be 6 inches in from the edge of the stone, and the next opening of the second flues must be 8 inches farther in, the bed of the cooling oven must be 4 feet 10 inches in length in the clear, and five and a half feet across to where it meets the groin arch of the stock hole; from the length of the flattening oven in the inside clear to the inside of the back wall of the cooling oven is 10 feet long, the back end wall and all the other walls after the mason work is levelled are built of brick, the end wall 2 feet thick, front side walls 18 inches, back side wall having an alternate bevel, that is it bevels from the mouth of the stock hole in upon the back side of the cooling oven from 14 inches to 9, and from the end wall of the flattening oven from 2 feet to 9 inches, each bevel extending 9 feet 3 inches each way, making the stock hole pass from the lower end or back part of the cooling oven, in an angular direction, whose nearer point is the groin arch, opening into the flattening oven, and 4 feet 6 inches from the lower or back wall of the cooling oven there is an opening left to build an angular arch which opens into the cooling oven, at the back side of the cooling stone, the height and breadth of this arch is similar to that of the flattening oven, but in place of four outlets or flues this has but one, the flues in the flattening oven tunnel being 4, are 4 by 6 inches wide at the outlet or entrance into the oven, and the head or deliverer of the cooling oven tunnel is 6 by 8 inches and carried up over the cooling stone 8 inches.

The bed of the oven being made of rough mason work as before stated, and the before mentioned arches turned, the mason work of the walls and stock hole

laid off, the clay for making the floor of the flattening and cooling ovens ought to be preparing: this may be made of any stiff clay and sand intermixed with a sufficient proportion of horse manure and hay seed. The use of the horse dung and hay is to sour the clay, and when laid in on the floors to prevent its cracking open while it is drying. As soon as the back wall at the inside of the flattening and cooling ovens are raised to a sufficient height, the outside wall at the back is also carried up, which is to the height of 18 inches at the lower end and 2 feet at the upper, or end entering into the flattening oven, which entrance must finish with a groin arch. The centres are set and an arch turned over it till within 2 feet of the bottom of the stock arch, where there is a flue made in the head of the arch of 6 inches square to take off the smoke and heat that enters from the flattening-ovens, and after the centres are drawn from the stock hole arch, which is best done as the arch is turning, the height, as before described, and the breadth throughout 14 inches, there is an outside arch cast equal with the back front of the wall, where the boy puts the cillenders into in front of the main stock hole arch, and as may be said blinding it, only, 12 inches high. Four feet 10 inches from the inside of the front wall of the flattening oven there is another arch sprung, directly over where the flattening and cooling stones join, 2 feet 8 inches high and 2 feet wide, which arch is filled with what is called a mantle stone, made of refractory clay, as any filling made with common mortar would vitrify and be constantly dropping on the glass, which passes from the flattening stone, under the mantle stone, to the cooling stone, where it is suffered to remain a short time to temper gradually before it is set up. The arch to be turned over the flattening oven should be, but 3 feet 4 inches high and the mantle arch divides it from the arch of the cooling oven, which arch must be 4 feet 10 inches high. Directly in the front of the flattening oven there is an arch turned 3 feet wide, and 2 feet high; the base of the arch must be on a level with the flattening stone; the door of the cooling oven is placed in the side wall, 3 feet from the mantle arch, and 7 feet from the back of the oven. The door is 20

inches wide and 2 feet 6 inches high, turned with a sharp gothic arch; 18 inches from the level or floor of the oven, there are holes left called strong holes, in the front wall of the oven, 4 inches square, and, correspon-ding grooves in the back wall of the oven, to receive bars of iron to support the sheets of glass on; the first of these holes are made 16 inches from the inside of the back wall of the oven, and, the other two, 16 inches apart. The clay for forming the bed or floor of the oven is laid on as compact as possible, and laid so as to be on a level with the door of the cooling oven, and on a level with the front arch of the flattening oven, but care must be taken, to leave space enough, for bedding the flattening and cooling stones, which ought to be half an inch higher than either floor; when the floor is laid it should be hammered or beat twice a day with a wood-en mallet, and as it dries some sand sifted on it through a No. 8 sieve, all over the flattening and cooling oven floor, and pounded in, which serves to stop any small cracks that may occur; when the surface of the floors are pretty dry, they should be smoked gradually and then the fire raised to its full height, and after they cool again the flattening and cooling stones should be put in and firmly bedded and levelled, and any space between them and the floors filled with moist clay, then the man-tle stone set and a layer of dry raw clay spread over both stones, then the ovens shut up again and the great-est care taken to temper the stones and bring the ovens again to a white heat, after which they are ready for work. There should be a coat of clay, lime and horse dung, brought to the consistence of mortar, laid pretty thick over the outside of the flattening and cooling ovens.

The flattening and cooling stones should be 1 foot 10 inches wide and 3 feet long, 6 inches thick each; the under part of them can be made of any clay till within 2 inches of the top, when equal parts of red and burned clay must be sifted through No. 20 sieve and well mixed, and then laid on the other clay and well beat in; and when nearly dry the flattening stone should be higher in the centre by ¼ of an inch than at any of the angles, which must be regularly graded or level-led from the centre outwards; and when brought to this

level the stone must be polished as smooth as possible; the cooling stone is brought to a dead level and finished off in the same manner.

Composition for Green Pots.

Nine measures of burned clay, 7 measures of raw clay. When you have pot shells, take 4 measures of pot shell clay, 5 of burned clay, and 7 of raw clay mixed and moulded as before directed.

Of the tools necessary for making flint glass, the first is the stool or bench of 2 inch plank, with 2 arms bevelling outwards; the right arm fortified with a thin plate of iron raised ½ an inch, to prevent its burning; at the same end of the stool, and on the overjut from the right arm, there is a band of iron fixed in which are pins of the same metal, to hold two or three pair of tools, made much like sheep shears, but having longer bits and a blunt edge; some are for opening tools, and others for cutting down, and all have a spring which makes them open of themselves, a shears with short bits to cut glass, a pincers and callipers. There ought to be three pair of shears, or precetlers, 1 pair scissors and 1 calliper to each chair. The blowing pipes are all hollow and if girted will measure 1¾ inches round, and should be 4½ feet long, the punties are all solid but thicker at the handling end than the other, and of the same length as the pipes; there should be 6 pipes and 2 punties to each chair; there is also a small iron paddle with a wooden handle attached to each chair; there are two marbles or plates of metal, well polished, 10 by 14 and ½ inch thick, and two small ones, 8 by 10 inches, attached to each side of the glass house; there ought to be 6 or 8 pigs of metal, 6 inches long, 2½ wide, and 3 inches high, coming up to a bevel each way with grooves in them for the irons to turn round in whilst gathering the metal or warming in at the pot hole.

The pot carriage is a bar of 2 inch square iron, into which there are two tongues of iron fastened by nuts and a screw; on each tongue 14 inches apart in the centre of the cross bar, into which the tongues are fastened, there is a long bar fixed at the contrary side from the

tongues and about 6 feet long, to serve as a handle at the extreme end whereof there is a cross piece to work it by; the wheels, which also run on the ends of the main cross piece should be eight inches in diameter and are made of cast iron; the squaring bar, pot bars, teasing bars, rakes and hoes, I think unnecessary.

The tools for a green glass works are far more simple than these for flint works, they must have a trefort to stand before the pot and rest the iron on whilst they warm in a block with water in on the bench or stool whereon they work, (for they do not set down as the flint glass makers do,) in this block or trough they have an iron crotch set about 6 inches high while they rest the end of the iron on it that has the glass on and smooth it with an iron paddle similar to the one before described; they then have another block at the foot of the bench, which as they blow at one end the glass is turned and formed to the required shape at the other end by means of the block; a small rod with a turn or hook an inch and a half long, called a picker, a pair of stiff long jointed iron pincers and a cracking iron; for the cooling oven there is an iron rod to take the cylinder out of the groin arch of the stock hole and lay it on the flattening stone and another to which is attached a small piece of soft wood to level the surface of the sheet with, these pieces can always be replaced when worn out, at the cooling oven there is a setting up fork made similar to a Neptune's trident, but divested of the centre prong. There are several other small irons wanted which it is unnecessary to describe, as the necessity or ingenuity of the workman will always teach him how to supply himself.

Of the substances employed in the composition of Glass.

The materials used to give a body to glass, are sand, flint, talc, spar, and some other stoney and terene substances. Sand or silex may be obtained from various sources, and of different degrees of purity, according to the fineness of the glass required. The siliceous matter generally used is sea sand, which is well

known to consist of minute round grains of quartz and is already sufficiently small to be used without any other preparation than that of washing for common glass. In the infancy of glass making, flints, ore or fusible spar stone were made use of as a principal stock in the batch, or mixing, not from any analogy they bear to that substance, but from the readiness with which they vitrify and amalgamate with the other alkaline and colourific ingredients of which glass is composed.

The goodness of flints must be distinguished by their uniform black colour, and also when they are broke into thin scales that they become semi transparent. All such as are marbled with brown or yellow streaks should be rejected for fear of iron, which frequently lurks in them under that appearance, and is very injurious to the colour of glass if it gets admission into it; such pieces therefore should be carefully picked out when found in parcels of the clearest sort; but if the greatest part of any parcel appears so marked, it should not be used till trial be made of a small quantity, that it may be known whether the discoloured veins contained in the flint would be injurious to the colour of glass or not. Flints must be prepared for making glass by being heated red hot and immediately quenched in cold water. The heat whitens them and the water splits them in every direction, by which means they may afterwards be ground in mills without much difficulty. The rounded lumps of white quartz found so abundantly in the beds of rivers in many mountainous countries, are often used for making glass, being first heated and ground to powder in the same manner as the flints. Talc of various species has been likewise used in making glass, but seldom in large works. It sometimes needs a calcination in order to its preparation, for entering into the composition of glass, but neither so great a heat nor the quenching in cold water are necessary for bringing it to a proper texture for reducing it to powder. Some sorts of talc are much more fusible or vitrifiable than others, and fusing easily with either salt of tartar or lead, may therefore be used in default of flints, or sand, sufficiently white. But with respect to larger manufactories, the use of flints is more eligible,

as they can be procured in greater quantities with more certainty, and will in general require much less flux and fire to bring them to a due state of vitrification.

But the difficulty of procuring and the cost of preparing both the flint and fusible spar, are superseded by the admission of sand in their place As the use of sand is so general in glass making, I shall point out the best for the purpose, and the methods whereby any substance inimical to glass contained in it may be discovered. The sand now in general use in England, Ireland, and Scotland for making flint glass, is got at the Isle of Wight, in Hampshire, where it is very pure and inexhaustible. Sand fit for glass making should be free from loam or clay, iron, or any other metal, isinglass or micah. In order to guard against the aforesaid mixtures it is subject to the following process, it is put into an oblong trough 12 feet long, 5 feet wide and 20 inches high, in which at one end there is a lifting door to let out the water, loam, &c. and two feet and a half farther up in the box there is another partition with another lifting door into which the water, loam, and a part of the sand enters; in washing, the sand subsides and is drawn aside with the hoe whilst the loam and other dirt that washes out of the sand passes to the lower part of the box and is there discharged. After the sand is well washed, which is known when no more froth arises on the water and its running off quite clear, it is well drained and then burned perfectly red in an oven prepared for the purpose, and when cold it is sifted through a sieve No. 26 or 30. If sand has iron in it may be known by its colour when burned, as it will be overspread with a great number of brown rusty specks, and if the magnet is applied to the surface of it the iron will be attracted and stick to the magnet according to the quantity contained in the sand. If it is impregnated with loam or clay it may be known by absorbing a great quantity of water in washing. But this inconvenience can be in a great measure remedied by burning the sand, for the heat will bake the clay into lumps which will not pass through the sifter and is by that method nearly all got out; but if there yet remains any, as it will not melt into glass, it is thrown to the top of

the pot when the glass is in fusion, and is taken off in the skimming which always precedes blowing. The next injurious body in sand is micah or isinglass; it is a bright, shining, unmeltable substance of a very irregular form and may be seen shining on its surface like pulverised glass. The only remedy yet found against this substance is the sieve, for whatever particles of it gets into the mixing will remain unaltered and is not acted on by the action of either fire or flux, and will be always seen in the manufactured glass in small transparent specks. If sand impregnated with iron is used it will in a great measure retard the effect of the colourific and crystalising ingredients, as it tinges glass of a green colour more or less dense, according to the quantity of iron contained in it. Such sand is by no means fit to enter into the composition for best flint glass, pastes, or looking glasses. The sand commonly used for making glass at and about Pittsburg is got at Perryopolis. The sand used at Boston and Chelmsford often comes from Demarara in the West Indies, and is brought there as ballast in vessels from that place. The sand used at Utica and Sandy Lake comes from the Delaware river, and is got both at New Castle and Burlington. There is also a kind of soft silicious stone, apparently like marble, found at Rome in Oneida county, state of New York, that when pounded, washed and burned, melts readily and is very pure. There is also very good sand found at Limestone, Kentucky, at Zanesville, and in the forks of Youghiogany, and Monongahela.

Wood ashes enters into the composition of green glass as a flux. It should be free from dirt and well burnt. The best method for testing the goodness of ashes is by weight, for well burnt ashes usually weighs one-third heavier than those which are taken away as quick as the wood is reduced into ashes. To render wood ashes equal in all its parts, there are ovens in every glass house where they enter into the composition for burning them. They should be burned from a light grey to a dark brown, and will be found after being pulled out of the oven and left to cool in lumps of various sizes, and also in minute particles, but always

of a uniform dark colour. The sifters used for ashes ought to be from No 36 to 40.

Pot and pearl ashes are used as fluxes in glass, in different degrees of purity, according to the quality of the glass for which it is intended. As wood ashes is the basis from which pot and pearl ashes are got, I shall describe the process of extracting it. Having provided a sufficient quantity of well burnt wood ashes, and they would deliver their salts more freely if laid up in a heap for three or four months, and having provided a sufficient number of tubs made of cedar or white pine, place the tubs on stools 18 inches or 2 feet from the ground; then put a layer of straw and pine or poplar saw dust in the bottom of each tub six inches deep, or straw alone will answer; over the straw, &c. place a shifting bottom, which ought to be full of holes to let the ley run through on the straw and saw dust. Where the manufactory of pot and pearl ash is carried on on a large scale, there ought to be from twelve to eighteen of these tubs placed in a line, over which a trough is placed, and a hole with a plug in each over every tub, in such a manner that water can be conveyed to either of the tubs at pleasure. Fill your tubs with ashes and let the water in on them, and let the ashes soak thoroughly until the water stands above them; let them continue so over night; then draw out the faucet and receive the ley in another tub, put under the first for this purpose; if the ley looks troubled pour it again on the ashes, and let it settle until it is clear and is of an amber colour. Put this clarified ley by, and pour on fresh water; let this also stand over night; then draw it off, and you will have a weak ley, which, instead of water, pour upon fresh ashes. After you have made a sufficient quantity of ley, pour it into an iron cauldron, bricked up like a brewing or washing copper; but let it not be filled above three parts full. On the top of the brick work place a little barrel with ley, towards the bottom of which bore a hole, and put a small faucet in to let the ley run gently into the cauldron, in a stream as thick as a straw; but this must be managed according to the quantity of the ley, for you must know how much the ley evaporates and make the ley in the barrel run pro-

portionably to supply that diminution. Care must be taken that the ley do not run over in the first boiling; but if you find it will, put some cold ley to it and slacken the fire, and let all the ley boil gently to a dry salt; when this salt is dry break it into lumps as big as a man's fist, and put it into the fritting oven, and raise your fire by degrees till the salt is red hot, yet so as not to melt it. If you think it calcined enough, take out a piece and let it cool; then break it in two, and if it is thoroughly white it is done enough: but if there remains a blackness in the middle it must be put in the calcar again until it comes out completely white. If you would have it still finer, you must dissolve it again, filtrate it, boil it, and calcine it as before; the oftener this is repeated the more will the salt be cleared from the earthy particles, and it may be made as clear as crystal and as white as snow; by the addition of pearl ashes, so purified, with silex and other fluxes, the best kind of flint glass can be made. But for diamond paste glass, or glass made to imitate diamonds, pearl ashes must undergo a more perfect purification to deprive it of its phlogistic properties, as without being properly purified it gives the glass into which it enters a yellow tinge, which greatly injures its brightness and beauty. Take any quantity you please of purified pearl ashes, and grind or pound it fine, then take half its weight of salt petre, pounded fine, mix both well together, and have a crucible so fixed that you can put it in and take it out of the fire with ease; half fill the crucible with this mixture, as on account of the ebullition of the salt petre it will bear no more; when you see that it has done burning and is settled down in the crucible clear and pellucid like melted glass, take it out and spill it upon a clean iron plate that has been wet with clean water; fill your crucible again and repeat the operation as long as there is any of the mixture remaining; then secure the purified pearl ashes in earthen jars, kept close stopped from air or moisture This is the best method of purifying pearl ashes, as the nitre burns off the phlogistic matter contained in it, but on account of the expense attending this method of purification it is only admitted into the composition for pastes and lock-

ing gl ss plates. The best ashes for making pot and pearl ashes, in England, are got from burnt thistles and hop stalks after the hops are gathered, and among trees the mulberry is reckoned to afford the best sort. The most thorny and prickly plants are observed to yield better and more salt than others; also, herbs that are bitter, as hops, wormwood, &c. Tobacco stalks when burnt produce likewise plenty of salt; and it is observed that fern ashes yield more salt than any other ashes; the stalks of potatoes, when cut just as the blossoms begin to drop, and laid by to dry, yield as good ashes and as great a quantity of salts as any other known substance. Barrilla, a plant cultivated in Spain for its ashes, from which the purest mineral alkali is obtained. It is procured from the incineration of different sea plants, chiefly in Spain and Italy, where whole fields are sowed with them by farmers, to good advantage, from this impure and mixed mass of cinders is obtained the marine alkali. The discovery of the use of these plants seems to be a present of the Saracens to the Europeans, for no mention is made of it before the Mahometan era.

The manner of preparing these ashes usually is thus: When the plant has attained its full height, they cut it down and let it dry; it is afterwards burned and calcined in pits similar to lime kilns, dug for the purpose, which are covered up with earth, so that no air may come at the fire. The matter by this means is not only reduced into ashes, but by means of the salt juices united into a hard substance, which is disengaged from the pits with hammers. The Spanish barrilla is reckoned the best and is generally sought after in preference to any other, for the purpose of making green window glass.

Kelp, is made from sea weed, thrown ashore or forced from its bed in the ocean by means of storms, it is gathered in great quantities on the sea coast of England, Ireland and Scotland, put up in heaps when dry, and burned, forming masses of different sizes, by the action of the salt contained in the plants, in a similar manner with the barilla, but not so pure and strong. It is chiefly used as a flux in black bottle manufactories.

Lime, for glass making, should be made of the purest stone, free from iron or isinglass, if it is impregnated with iron, it gives the glass a greenish yellow tinge, and if it contains isinglass or micah, it will be seen in the glass when manufactured, in small transparent specks, subjecting the articles in which such specks are, to be stained, sooner or later, and of course of no further use to the owners. If lime stone can be procured, free from ore, loam or micah, it will take one ton weight, to make eleven hundred weight of good lime; the lime that enters into the composition of glass, should never be slacked with water, only such part of it must be taken as is slacked by the atmospheric air, and sifted as hereafter directed.

Lime made from Carara marble, or oyster shells, is purer than any other lime, and superior to any other for making glass. The shells are prepared in the following manner: They are well washed, and put into an oven similar to one described for pots, to go with wood the action of the fire reduces them to an impalpable powder without the aid of fire or water; they undergo a similar decomposition, when coals are used; but the oven must be on the same construction as the coal oven, for tempering two pots After the lime is well burned, which if made of stone, will take from three to three days and a half, but if the shells are at hand thirty hours will be sufficient, it must be put into a clean close room free from dust and moisture; then have a sifting box 8 feet long, 4 feet wide, and 2 feet 10 inches high, fitted with a close cover, made in two parts, 4 feet 2 inches long, one part of which must be made to lift occasionally; in the box are placed cleets and slides for the sifter to run on, the sifter should be made square and of brass wire No. 40, and should have a cover fitted to it, and a shifting handle, sufficient for sifting the lime in the box. The cause of all this carefulness is to prevent the escape of the most useful and finer parts of the lime which would fly off if sifted in an open box.

Common salt, is only made use of in America, but the French, Spanish and Germans, make use of it in what they call their flint glass. But their compositions,

though white, is not possessed of that brilliancy and weight by which glass made with lead is distinguished; but, though salt renders glass white and clear, yet, if admitted in two great a quantity, it will make the glass very brittle. Glass overcharged with salt, is often known to crack or fly, when empty, with a considerable noise.

When salt is used in the composition of glass, it ought to be scorched to a redness, or till it is done crackling, before it is put to the mixing, being so full of air if put to the mixing without scorching, it will cause so great an ebullition, in the rest of the materials, that the best part of the flux is thrown over before it has time to operate or produce the necessary change for which it is intended on the rest of the materials.

Nitre, or salt petre, is found granulated and intermixed with various earths, in almost all parts of the world, but no where in so great a quantity, as the East Indies; it is also found in great abundance in America, particularly in a great number of spacious caves, in Kentucky.

It has been manufactured in France, and Germany, in great quantities from various substances, by the following process: Large quantities of earth, and rubbish are gathered from the foundations of old houses, stables and barns, together with dried cow and horse manure, and horse and cow litter, swallows nests, pidgeon's and chicken's manure. All those materials are made up indriscriminately into heaps, from four to five feet high, and four feet square at the bottom, terminating in a point at the top. These heaps ought to be placed under sheds which are open all round, and admit a free circulation of air, each heap under a separate shed; they should be well saturated with human urine, which after being continued 12 or 14 days, will cause these heaps to threw out a whitish kind of scruff or covering, which being collected is leeched like pearl ashes; the water is then boiled, and when it has boiled sufficiently, is known by flirting a drop of it on a live charcoal and it will flash like gun powder, and upon trial one hundred weight of this liquor contains about thirty-five pounds weight of salt petre. Before its second boiling

it is filtered through wood ashes, put into tubs sifted; but the bottom of the tub must be laid a foot deep, with straw over this place, loose boards near each other, and over these a little more straw; then fill the tubs to within half a foot of the top with wood ashes; then pour the liquor as it comes scalding hot from the copper, on one tub, and after letting it stand a while, draw it off, and pour it on the other, thus continue pouring it on and drawing off till it grows clear and looses the thick turbid colour it had when first put on. By filtering the liquor all i s greasy oil is left in the ashes, and it is to be set by for another boiling. To bring away what is remaining of the liquor in the ashes pour on common water once or twice made very hot. When you begin your second boiling put first into the copper the liquor that went last through the ashes, and as that boils down let the strong liquor drop into the copper, from a tub placed over the copper on the side of the furnace, continuing the boiling till the liquor in the copper be ready to shoot or crystalize. You will observe when it is near done boiling, there will arise a scum and froth on the top, which is to be carefully taken off with a brass skimmer, and the salt which falls or forms at the bottom of the copper is also to be taken and laid aside for another use. To know when the liquor is ready to shoot into petre, drop a little of it on a knife or any other cold and smooth piece of metal, it will coagulate like a drop of tallow, and not fall from the knife if turned downwards. The liquor will now contain about 70 lbs. weight of petre in every hundred weight. The liquor is now to be taken out of the copper with iron ladles, and put into a deep or high narrow tub, and when so cold that you can bear your finger in it, you will find the common or cubic salt begin to granulate and stick to the sides of the tub; then at a tap, placed about half a foot from the bottom, draw off the liquor into deep wooden trays or pans, which put into some cool place and let stand for the salt petre to shoot; which it does, and of various colours, as white, yellow, blackish, &c. It is now ready for refining.

To refine salt petre, dissolve it in about six times its weight of boiling water; filter, evaporate, and crystal-

ize it as you would other salts. The salt which sticks to the sides and bottom of the settling tub is of the nature of common salt, and should be refined by itself. It is excellent for salting beef and bacon.

When the liquor has stood 48 hours, that part of it which is not coagulated, but swims on the petre, must be carefully poured off, and being mingled with new liquors in the first copper, must be passed through the ashes before the second boiling. It will then produce more salt petre.

Nitre, or *Salt Petre*, is a very powerful flux in glass, and when it is pure and good itself, is a very great purifier of the other materials composing the composition, as it takes away the yellow colour communicated to glass, on account of the impurities contained in the pearl ashes and red lead, and is next to borax, the most powerful flux admitted into the composition.

Borax is a saline substance, found in Thibet and China. In the former place it is procured from a lake situated among the mountains, fifteen days' journey from Tisoolumbo, the capital, and entirely supplied by springs, no streams either falling into or flowing from it. The water has a salt taste, and contains both borax and common salt, and, on account of its elevation, is frozen for a great part of the year. The edges and shallows of the lake are covered with a stratum of borax, which is dug up in considerable masses, and the holes made are gradually filled by a fresh deposition. From the deeper parts of the lake common salt is procured. The borax in its rough state is called tincal, and is brought to Europe in the form of a brownish grey impure amorphous salt, or in detached crystals about an inch in length, of a pale greenish hue, and in the form of compressed hexahedral prisms. Method of purification is to boil the borax strongly and for a long time with water. This solution being filtered affords, by evaporation, crystals which are somewhat foul, but may be purified by repeating the operation; then expose it to a low red heat, and any grease contained therein will be burned off. It is the most powerful flux for glass of all the salts, or indeed of any known substance whatever, but on account of its great price

can only be admitted into the composition for looking glass plates, or other purposes where a considerable value can be set on the produce, or where the quantity wanted is very small.

Red Lead is made in an oven much like a baker's oven, with a low vaulted roof, and on each side of the furnace or oven there are two party walls rising from the floor of the surface, but not reaching to the roof; in the interval between these walls and the roof and sides of the furnace, the grates are formed and fire placed, the flame of which draws over the top of the side wall of the grate, and striking the roof is thence reflected down upon the surface of the lead which is laid upon the floor of the oven; the metal soon melts, and instantly becomes covered with a pellicle, which is successively raked off till the whole is changed into a greenish yellow powder. This is taken out, ground in a mill, and washed, to separate the portion of lead that still remains in a metallic state, by which it becomes a uniform yellow colour, and is then thrown back into the furnace and constantly stirred, so as that every part may be equally exposed to the action of the flame. In about 48 hours of calcination it is converted into red lead. Red lead used in a due proportion, makes a tougher and firmer glass than can be procured from salts alone, and is yet procured at a small expense; but all the glass of which lead forms a part, is tinged with a yellow colour, and therefore requires the addition of nitre to destroy the sulphuric or phlogistic matter it contains, in order to bring it to a more colourless state, which addition of nitre enhances the price of glass; for if it was not for the addition of salt petre and borax, glass would be exceeding cheap. There is another reason also for the addition of nitre or some other salt to operate as a flux to the glass compounded of lead, which is, that there may not be a necessity of using beyond a certain portion of it, for if the glass has much lead in its composition, it will suffer a corrosion by means of atmospheric air, which gives a greyish dullness to its surface that in a great measure destroys its beauty.

Litharge is lead under a different name, and is produced in refining the lead, and in separating lead from silver, it is of singular use in fluxing glass as it melts by itself into a very dense, clear, yellow, transparent glass, remarkably soft and unctious to the touch, fusible at a low red heat, and when melted, acting so powerfully on all earthen vessels as to run through the common porous crucibles in a very short time, almost like liquor through a sieve, but vitrifying and corroding the bottom of the crucible in its passage. Litharge is a most powerful flux to all earthy mixtures, and it imparts to glass the valuable qualities of greater density and greater power of refracting the rays of light and of bearing sudden changes from heat to cold.

Arsenic is used as a flux and colourific ingredient in glass. It is a sure and subtle poison, and if too much is used in the compound, the glass into which it enters is not absolutely safe or fit for use. Some glass-mixers use it in all compounds, but it is not necessary but for the following compositions.—White enamel, of which it is the basis; flint glass, which it clears and fluxes; looking-glass plates, crown glass, and white cornelian. Arsenic, if unadulterated, is very white and even semi-transparent, and very heavy; but if of a dull heavy white, the substances with which it is or may be adulterated, are bones calcined to whiteness, and lime; but the glass mixer should have it in clear semi-transparent lumps, and grind and sift it through a No. 50 sieve himself. If adulteration is suspected, dissolve the arsenic in eighty times its weight of hot water: the arsenic will be held in suspension, and the particles with which it is adulterated will be precipitated and fall to the bottom of the glass.

Manganese, frequently called glass maker's soap, from its great use in correcting the bad colour of glass as well as giving it a colour of itself. It is always found in the neighborhood of iron ore, and is very little different from it in colour. It ought to be well burned, then pounded and sifted through a fine sieve, after which it is fit to enter into the composition. From four to six ounces of it is sufficient for a pot of glass. It aids all the other fluxes considerably, destroys the phlogiston

or yellow, too often contained both in red lead and pearl ashes, and gives to the glass, in place of the yellow tinge communicated by these articles, a pleasing light blue cast, bordering on a water colour. But if too great a quantity of it is admitted into the mixing, it will give the glass a purple colour, bordering on a dirty black, which ought to be avoided. It is used in conjunction with calcined copper, to make blue and sapphire coloured glass; it is also used in black, combined with zaffer and iron. It is used with all the colouring compounds, and if looking glass mixings have any tincture of yellow it is admitted in small quantities to correct it.

Antimony.—The perfect oxyd of this metal gives a full yellow to glass which is much used, both alone and in compound colours It also makes glass of a brown colour, combined with manganese.

Zaffer is used for giving a fine deep blue. Cobalt also gives a fine fixed blue, which is unalterable by fire. Cobalt and zaffer, combined with manganese and iron, are used for some of the finer blacks.

Iron.—The shades of colour produced by the oxyds of iron are very numerous. In the general account of glass making it is observed that a very small portion of iron, fully vitrified with a large body of glass, gives different shades of green and yellow, and to this the colour of common green bottle glass seems to be owing. A larger dose of iron gives a yellow after thorough vitrification, and a still larger gives a brownish black, which seems to be only a yellow very much concentrated.

Copper.—All the oxyds and carbonated oxyds of copper produce a fine green when thoroughly vitrified with any kind of glass or flux, and this colour is one of the easiest to produce. In experiments in the small way, there does not seem to be much reason for preference of one preparation over the other. Those most frequently employed are the carbonated oxyd produced by adding a carbonated alkali to the sulphat of copper, and also the aes ustum or copper oxydated and calcined simply by access of heat and air. This metal however, may be made to give a carmine red (or mixed

with iron a full deep red) by adding to the glass containing it a quantity of tartar, when in fusion, and working off immediately. The oxyd of copper must, in this case, be reduced nearly to the reguline state. A greater continuance of heat restores the green colour. The oxyd of copper is also often mixed with manganese and iron, in the composition of the full bodied black glass. This oxyd when combined with thrice its weight of alumine, runs in a strong heat into an opake red enamel.

Calcined Tin.—The oxyd of tin resists fusion more strongly than that of any other metal, from which property it is useful to form an opake white enamel, when mixed with pure glass in fusion.

Some tin is melted in an iron vessel, with a low red heat, and the oxyd that forms on the surface, is successively removed till enough of it is procured. This is then spread on a red hot muffle, and heated for half an hour with frequent stirring, to complete the calcination of any particles of tin that may be entangled in the oxyd. When cold it is powdered and sifted, and the finer part is again calcined for six or seven hours on a muffle till it becomes almost white.

Gold has long been celebrated for giving to glass a most exquisite purplish red resembling the ruby, and nearly equalling it in beauty. It is both the most exquisite, splendid and expensive, of all the artificial coloured glasses; but the management seems to be extremely difficult to ensure the completest and most uniform success, principally, as may be supposed, from the great tendency of gold to assume the reguline state by means of heat, by any carbonaceous vapor, or by hydrogen. The most celebrated as well as the commonest preparation of gold, for giving a purple to glass and porcelain, is the purple precipitate of cassius, or gold precipitated from its nitro muriatic solution, by, and together with, the oxyd of tin; the usual way of making it is, to dilute very largely a solution of gold in aqua-regia (formed by about 3 parts of nitric and 1 muriatic acid) and add to it drop by drop a very dilute nitro muriate of tin, well saturated with this metal. The liquors immediately become of a purplish red

colour, like port wine, and by standing a precipitate of this colour, with some varieties of shade, slowly subsides. A similar precipitate also takes place with the nitro muriate of gold, and the pale muriate of tin, and also with great certainty, by immersing a stick of tin in the dilute solution of gold. Though the change of colour always takes place when the nitro muriate of tin is used, the precipitate sometimes fails to separate without any apparent reason. This substance is a most intimate mixture of the oxyds of tin and of gold.

Whenever the purple precipitate by tin is used, it appears to be the practice to add about one sixth its weight of the perfect white oxyd of antimony by nitre, or else of glass of antimony. This naturally gives a yellow; and it seems by experience to be a very important ingredient in the composition of the fine ruby glass.

Silver.—The oxyd of silver is used in glass making to give glass a fine yellow colour. When used as a colourific, the fire must not be urged too fast, as that will make the colour fly, and the glass will become transparent.

Burnt Bones.—There are two methods of burning bones—the one white and the other black. If bones are burned in a luted crucible, owing to the fixed oil contained in them they will be burned into a black mass, which being ground in a mill produces ivory black; but if bones are burned in the open air, the oil flies off, and they are burnt into a white powder, which being ground and sifted, will give glass that opaque colour called white enamel; but in using bones and arsenic, the fire must not be too strongly urged, as that volatilizes the arsenic and reduces the bones to a pelucid glass.

GLASS COMPOSITIONS.

No. 1. *Flint Glass*—120 lb. of white sand, well washed and burned, 50 lb. of red lead, 40 lb. of best pearl ashes, 20 of salt petre, 5 ounces of manganese, 12 ounces of arsenic.

No. 2.—120 lb. of white sand, 40 lb. of pearl ashes, well purified, 35 lb. red lead, 13 lb. of nitre, 4 ounces of manganese.

No. 3.—100 lb. white sand, 80 to 85 lb. of red lead, 35 to 40 lb. of purified pearl ashes, 12 lb. of nitre, and 3 ounces of manganese.

No. 4—120 lb. of sand, 54 lb. of pearl ashes, 36 lb. red lead, 12 lb. of nitre, 6 ounces of manganese. Add from one to two pounds of arsenic to this and No. 3.

No. 5—120 lb. of white sand, 35 lb. of best pearl ashes, 40 lb. of red lead, 13 lb. of nitre, 6 lb. of arsenic and 4 ounces of manganese, or 15 pounds of common salt may be substituted in place of the arsenic.

No. 6.—120 lb. of white sand, 30 lb. of red lead, 20 lb. of best pearl ashes, 10 lb. of nitre, 15 lb. of common salt and 6 lb. of arsenic. This requires a strong fire to burn off the arsenic.

No. 7.—240 lb. of sand, 60 lb. of good pearl ashes, 28 lb. of red lead, 12 lb. of salt petre, 4½ lb. of arsenic, 5 ounces of manganese, and 116 lb. of broken glass.

No. 8.—120 lb. sand 30 lb. pearl ashes, 16 lb. red lead, 8 lb. salt petre, 3 lb. of arsenic, 3 ounces of manganese, 60 lb broken glass.

No. 9—120 lb. of sand, 35 lb. of pearl ashes, 16 lb. of salt, 14 lb. of lime, 3 lb. and 3 ounces of arsenic, 80 lb. of broken glass.

No. 10.—120 lb. of fine sand, 40 lb. purified pearl ashes, 35 lb. of litharge, 13 lb. of nitre, and 4 ounces of manganese, to which add half the whole weight of broken glass.

No. 11.—120 lb. of white sand, 50 of red lead, 40 of the purest pearl ashes, 20 of nitre, and 5 ounces of manganese, and broken glass half the whole weight.

No 12.—120 lb. of white sand, 54 of the purest pearl ashes, 36 of red lead, 12 of nitre, 6 ounces of manganese, and 1½ lb. of arsenic, and the usual quantity of broken glass.

No. 13—120 pounds of white sand, 30 of red lead, 20 of the best pearl ashes, 10 of nitre, 15 of common salt, and 6 of arsenic, 3 ounces of manganese, and 100 pounds of broken glass.

No. 14—100 pounds of sand, 80 to 85 of red lead, 35 to 40 of nitre, and 2½ ounces of manganese. The lead may be reduced in this mixing, but a sufficient quantity of broken glass must be added.

No. 15.—120 pounds of clean white sand, 40 of purified pearl ashes, 35 of litharge or red lead, 13 of nitre and 4 ounces of the black oxyd of manganese, to which add 100 pounds of broken glass.

No. 16—100 pounds of fine sand, 80 of good pearl ashes, 45 of red lead, 14 of nitre and 2 ounces of manganese; broken glass as before specified.

No. 17. *German Crystal.*—120 pounds of calcined flints or pure white sand, 70 of best pearl ashes, 10 of salt petre, half a pound of arsenic, 5 ounces of manganese, 80 pounds of broken glass.

No. 18.—120 pounds white sand, 46 of pearl ashes, 7 of nitre, 1 of arsenic, 5 ounces of manganese, 100 pounds broken glass.

No. 19.—120 pounds of white sand, 15 of common salt, 80 of pot ash, 1 of arsenic, 45 of broken glass.

No. 20. *Crown Glass.*—300 pounds of good white sand, 180 of pearl ash or soda, 33 of lime, 200 of broken glass, 3 ounces of manganese, and 2½ pounds of arsenic,

No. 21. *Boston Crown Glass*—200 lb. of Demarara or Delaware sand, 80 lb of pearl ashes, 84 lb. of oyster shell lime, 3¾ lb. of antimony, 3 lb. of arsenic, 2½ lb. of antimony, 124 lb of broken glass.

No. 22. *Utica Crown Glass.*—300 lb. of good sand, 100 lb. pearl ashes, 100 lb. of lime, 4 lb. of arsenic 4 lb. of antimony, 170 lb. broken glass.

No. 23 *English Crown Glass*—240 lb. of sand, 100 of kelp or barilla, 18 of salt petre, 8 of arsenic, 1½ of antimony and 60 of lime, broken glass as before.

No. 24. *Common Green Window Glass.*—60 lb. of white sand, 20 of pot ash, 10 of common salt, 2 of arsenic, 2 ounces of manganese and 80 lb. of broken glass,

No. 25.—120 lb. of white sand, 30 of pot ash, 60 of wood ashes, well burned, 20 of common salt, and 2½ of arsenic; with this must be mixed half the weight of the whole compound of broken glass.

No. 26.—120 lb. of good sand, 40 of good pearl ashes, 18 of lime, 16 of salt, 60 of broken glass.

No. 27. *Made at Woodstock in York state*—240 lb. of sand, 90 of pearl ashes, 84 of wood ashes, 22 of lime, 1 of antimony, ½ lb. of cobalt and 142 lb. of broken glass.

No. 28. *Green without Pot or Pearl Ashes.*—15 bushels of sand, 25 of ashes, 8 of salt and 12 of broken glass.

No 29. *As made in most of the Glass Manufactories in the United States.*—6 bushels of good clean sand, 6 of wood ashes well burnt and sifted, 2 of pot ash, a bushel and 3 pecks of common salt, you may add broken glass or not. The above answers for a melt in an eight pot furnace.

No. 30 *Fredericktown Cillender and Bottle Glass.*—17 bushels of sand, 27 of ashes, 8½ of salt, 6 of pot ash, and 10 of broken glass.

No. 31.—120 pounds of good sand, 40 of good pot ash, 18 of lime, 16 of salt, 1 of arsenic and 60 of broken glass.

No. 32.—300 pounds of sand, 200 of soda or pot ash, 33 of lime, from 250 to 300 of broken window glass.

No. 33.—120 Pounds of fine sand, 40 of purified pearl ashes, 35 of litharge, 13 of nitre, 2 ounces of manganese.

No. 34.—120 pounds white sand, 50 of red lead, 40 of purified pearl ashes, 20 of nitre, 5 ounces of manganese and 160 pounds of broken flint glass, 1½ of arsenic.

No. 35.—120 pounds of sand, 54 purified pearl ashes, 36 of red lead, 12 of nitre, 6 ounces of manganese, 2 pounds of arsenic, and 160 of broken glass.

No. 36.—120 pounds of white sand, 35 of best pearl ashes, 40 of red lead, 13 of nitre, 4 pounds 4 ounces of manganese, and half the whole weight of broken glass.

No. 37.—120 pounds of white sand, 30 of red lead, 20 of best pearl ashes, 10 of nitre, 15 of common salt, 4 of arsenic, and half the whole weight broken glass.

No. 38.—100 pounds of sand, 60 of red lead, 40 of pearl ashes, 8 of nitre, 2 ounces of manganese, 2 pounds of arsenic and 100 of broken glass.

No. 39—120 pounds of sand or calcined fusible spar, 35 of good pearl ashes, 20 of lime, 1 of antimony, 1½ of arsenic, 80 of broken glass.

No. 40 *Green without Pot or Pearl Ashes*—Fifteen bushels of sand, 25 of wood ashes, 8 of salt, and 12 of broken glass.

No. 41. *Glass with brick bats and the scoria of iron foundaries.*--75 pounds of scoria, 25 of hard brick bats, 80 of sand, 60 of salt, 24 of pot ash, and 100 of broken glass. The scoria and brick bats must be pounded fine.

No. 42. *Cheap Green* —Eight bushels of sand, 12 of ashes, 4½ of salt, 2½ of black salts, 9 of broken glass.

No. 43 *Glass made from hard glass, that is from glass ladled out of the pots into water.*—To every bushel and a half of this glass well ground and sifted, add half a bushel of sand, one-fifth of a bushel of salt and a peck of pearl ashes.

No 44. *Looking Glass Mixing.*—300 pounds of the finest sand, 200 of soda, or pearl ashes purified with nitre, 30 of lime, 18 of borax, 8 ounces of manganese, 3 of cobalt, 300 pounds of broken looking glass plates. The sand, soda, lime and manganese are first mixed together with great care and then fritted together till the materials undergo no further change, the heat of the calcar being gradually raised to a white heat. This process lasts about 6 hours, when they are put into the pot and the broken glass and cobalt added.

No. 45 *Another.*—120 lb. of very pure sand, 50 of pearl ashes purified with nitre, 20 of borax, 1 of arsenic, 60 of broken plate glass.

No. 46. *Hard Glass, for pastes and colours.*—12 lb. of good sand, washed and burned, 7 of pearl ashes and ½ lb. of borax.

No. 47. *Another* — 12 lb. of sand, 7 of pearl ashes, 1 of saltpetre, ½ lb. of borax, 4 oz. of arsenic.

No. 48.--20 lb. of litharge, 12 of silex, 4 of nitre, 4 of borax, and 2 of white arsenic; frit these in a crucible and afterwards melt, then pour the whole into water, seperate any revived lead that may be found, and afterwards melt again.

No. 49.—Mix 20 lb. of ceruse, 8 of silex or powdered flints, 4 of carbonat of pot ash, 2 of borax; when melted pour into water, and remelt again in a clean crucible.

No. 50.--Mix 16 lb. of red lead, 8 of rock crystal in powder, 4 of nitre and 4 of carbonat of pot ash; melt and remelt as before.

No. 51.--Treat as above directed 24 pounds of borax, 8 of rock crystal and 8 of carbonat of pot ash.

No. 52.—Make a quantity of liquor of flints by fritting together three parts of alkali with one of rock crystal, which dissolve in water, and saturate with dilute nitric acid, drain off the nitric acid and dry the silex which is converted into a fine powder, then melt it in a crucible with 1½ its weight of very fine ceruse, and pour the glass into water, then break it down and melt it with 1-12th its weight of borax, and pour into water as before; lastly, melt this latter product with 1-12th its weight of nitre, and the result will be a very fine hard glass of extreme lustre.

No. 53. *Hard Glass for Black Glass.*—7 pounds of sand, 3 of pearl ashes, ½ pound of nitre; dip this into water, and to every three pounds add one ounce of manganese, ½ ounce of zaffer, one ounce of calcined copper and one ounce of calcined iron.

No. 54. *Diamond Paste Glass.*—Take of hard glass No. 3, 7 pounds, good sand 2½, purified pearl ashes 8 ounces, 1½ pound borax, 2 of red lead; when this glass is melted throw it into clean water and add half its weight of very pure broken glass, ¼ pound of arsenic, ½ ounce of manganese, ½ pound of borax and ½ pound of red lead.

No. 55. *Common Black Colour.*—Take all kinds of old broken glass pounded fine and add by different quantities zaffer and manganese to fix the colour.

No. 56. *Fine Velvet Colour.*—Take crystaline and pulverine frit, of each 20 pounds, calcined and pure calx of lead and tin 4 pounds, steel calcined and powdered and scales of iron from the anvil 6 ounces each.

No. 57. *White Enamel.*—120 pounds of sand, 40 of good pearl ashes, 12 of red lead, 10 of saltpetre, 16 of arsenic, 14 of burnt bone ashes, 60 of broken white enamel. This glass should be worked off quick, as the arsenic is apt to burn off by too long a fusion.

No. 58. *Another.*—10 pounds of hard glass, 1 of calcined horn, ivory or bone, or 2 pounds of white arsenic to 10 of hard glass.

No. 59. *Another.*—130 pounds of sand or calcined flints, 70 of nitre, 12 of borax, 12 of tartar, 5 of arsenic, 20 of powdered bone ashes or shavings of ivory.

No. 60.—60 pounds of white sand, 40 of good pot ash, 25 of finely powdered bone ashes; this glass is perfectly clear when red hot, but grows opaque as it cools.

No. 61. *Glass in imitation of Opal.*—Take 200 pounds of hard glass, No. 3, 10 of lunar cornea, 2 of magnetic iron ore and 40 of finely powdered bone ashes.

No. 62. *Blue Glass.*—100 pounds of hard glass without lead, 2 of zaffer, and ½lb. of manganese.

No 63. *Blue.*—A full blue may be made by adding 6 drachms of zaffer and 2 drachms of manganese to 10 pounds of hard glass.

No. 64. *For a Cool Blue.*—To 10 pounds of hard glass, add half an ounce of calcined copper in place of the manganese, and diminish the proportion of zaffer one half.

No. 65. *Crysolite.*—Take 10 pounds of hard glass and 1 ounce of calcined iron.

No. 66. *Glass resembling Sapphire.*—10 pounds of hard glass, 3 drachms and 1 scruple of zaffer, and 1 drachm of calx cassi, or one eighth the weight of the glass of smalt.

No. 67. *Red Cornelian.*—1 pound of glass of antimony, 2 ounces of calcined vitriol, called scarlet ochre, 1 drachm of manganese, to 2 pounds of hard glass. The glass of antimony and manganese is first fused with the hard glass and then the scarlet ochre is added.

No. 68. *White Cornelian.*—2 pounds of hard glass, 2 drachms of yellow ochre well washed, 4 ounces of burned bones; grind all together and fuse them or instead of the bones 3 ounces of the calx of tin.

No. 69 *Garnet.*—To 2 pounds of hard glass, add 1 pound of glass of antimony, 1 drachm of manganese, and 1 drachm of calx cassi.

No. 70. *Gold Colour.*—To 10 pounds of hard glass without nitre, add 10 ounces of borax, 10 ounces of red tartar, of the deepest colour, 2 ounces of manganese, and 2 drachms of charcoal.

No. 71. *Another.*—2 pounds of glass of antimony; 2 of red lead, and 3 of calcined flints; this glass looks well

No 72. *Saxon Green*—9 pounds of hard glass, 3 ounces of copper precipitated from aqua fortis, 2 drachms of precipitated iron.

In making hard glass for colours, they should be made on a soft basis, so as to fuse easily, because the colouring matter being generally metallic, oxyds would sometimes be reduced to a reguline state by too long a fusion, and the colouring matter contained in them destroyed.

When crucibles are used for fusing coloured glass, they should be armed or glazed, which is done while they are moist by sprinkling some powdered borax on the inside of the crucible, or some glass pounded fine and sprinkled on the inside of the crucible, then they are put into an oven and the fire gradually raised till the glass or borax vitrifies on the inside surface; after which they are suffered to cool gradually.

Method of Silvering Looking-Glass Plates.

After the plate glass is taken out of the tempering oven, it is squared; the plate of glass is then laid on a thin plate of free stone, or on a long wooden frame, of about the same size with it, and cemented strong by plaster of Paris. Another plate is also cemented in the same manner, and laid upon the lower plate, and wet sand is interspersed between the two. The plates are then made to rub against each other steadily and evenly, by a kind of hand mill, the wheel of which is worked by a man, and sometimes in large plates by two men, who can regulate the pressure of one or the other as it may be judged proper. In proportion as the surface of the plates wear down, the sand is used successively finer, being previously sifted and sorted for the purpose. In general the workmen avoid rubbing two absolutely rough surfaces on the other, for fear that the great jarring of the friction should produce shakes or flaws in the glass, but a half ground plate is rubbed on a fresh surface, and so on successively.

When one side of the plate is done, the plaster which cemented it is picked off, the plate turned, and the opposite side ground in the same manner. Towards the end of the grinding the pressure is increased by loading the upper plates with flat stones of different thicknesses. This process lasts three days, and great attention is paid to finish them with surfaces perfectly flat and parallel, which is determined by the rule and plumb line. The ground surfaces are now uniformly covered by millions of scratches, and therefore nearly opaque, unless held up to the light, but still very far from having the requisite fineness to receive the polish. This further grinding is done by emery of different degrees of fineness, the preparation and sorting of which is done in the following manner:—A large quantity of rough emery is put into a vessel with water, and strongly stirred about till the whole is mixed; but emery not being soluble in water, the whole will again be deposited in successive layers, the coarsest particles sinking first, and the others afterwards in the inverse degree of their fineness. By standing about twenty minutes, and then pouring off the superabundant liquor, the latter holds suspended only the very finest particles which again separate by rest for a longer time. More water is then added to the vessel, the emery stirred again, and now only allowed to remain at rest only 15 minutes. This furnishes emery of the second degree of fineness. The same operation is repeated twice more at the different times of five minutes and a half a minute, by which two other sorts are obtained. The wet emery from all these liquors is separately heated over a stove, and when nearly dry is made up into balls, in which state it is delivered to the workmen

The plates are then further ground on both sides, with two or three emeries, beginning with the coarsest, and are finished with great care. They are now perfectly even, with a deadening opacity on their surface; but so fine that no scratches can be perceived. In this state they are again examined, and if any material defects appear below the ground surface, they are cut up into smaller plates, rejecting the faulty parts. The next process is that of polishing both surfaces to that

perfect brightness seen in perfect mirrors, so that the rays of light may pass through unimpaired to the silvering on the posterior surface, and be reflected again from thence by the laws of catoptrics. The substance used for this purpose is colcothar—it is the residue left in the retorts of the aqua fortis makers, and when well washed and levigated, consists of little else than a red and perfect oxyd of iron.

The polishing instrument is a block of wood, covered with several folds of black cloth, with carded wool between each fold, so as to make a firm elastic cushion. This block has a handle for the workman to hold. He then moistens the polisher with a wet brush, covers it with colcothar, and begins his operation by working it backwards and forwards over the surface of the plate.

When one side is completed, and the reverse is about to be done, the polished side, now the undermost, is entirely covered with red colcothar, to prevent the dazzle reflected from the white plaster, which would prevent the workman from judging so accurately of the state of the surfaces on which he is employed. What is termed silvering of mirrors is applying to the posterior surface a coating of quicksilver, which metal when perfectly bright and brilliant, reflects the rays of light with great accuracy and beauty; but as this fluid metal could not be alone applied without great inconvenience, it is first made to adhere by a partial amalgamation to the surface of a sheet of tin leaf, and then, by the help of pressure, is applied closely to the glass in a very thin lamina. It is therefore properly a thin sheet of leaf tin, fully impregnated with mercury, that is the reflecting surface. The management of silvering is extremely simple. A perfectly flat slab of smoothed free stone, or sometimes of thick wood, a little larger than the largest plate, is enclosed in a square wooden frame or box, open at top, and with a ledge rising a few inches on three sides, and cut down even with the stone on the fourth. A small channel or gutter is cut at bottom of the wooden frame, serving to convey the waste mercury down into a vessel set to receive it. The slab is also fixed on a centre pivot, so that one end may be raised by wedges, (and of course the other depressed,) at pleasure, when working freely in the box.

The slab being first laid quite horizontal, and covered with grey paper stretched tight over it, a sheet of tin foil, a little bigger than the plate to be silvered, is spead over it, and every crease smoothed down carefully; a little mercury is then laid upon it, and spread over with a tight roll of cloth, immediately after which as much mercury is poured over it as will lie on the flat surface without spilling. That part of the slab which is opposite the cut down side of the wooden frame, is then covered with parchment, and the glass plates lifted up with care and slid in, holding it quite horizontal, over the parchment, and lodged on the surface of the slab. The particular care required here is, that the under surface of the glass should from the first just dip into the surface of the mercury, skimming it off as it were, but without touching the tin leaf in its passage which it might tear. By this means no bubbles of air can get between the glass and the metal, and also any little dust or oxyd floating on the mercury is swept off before the plate without interfering. The plate being then let go sinks on the tin foil, squeezing out the superfluous mercury, which passes into the channel of the wooden frame before mentioned. The plate is then covered with a thick flannel and loaded over the whole surface with lead or iron weights, and at the same time is tilted up a little, by which more of the mercury is squeezed out. It remains in this situation for a day, the slope of the stone slab being gradually increased to favor the dripping of the mercury. The plate is then very cautiously removed, touching it only on the edges and upper side, and the under side is found uniformly covered with a soft pasty amalgam, consisting of the tin leaf, thoroughly soaked with quick silver, and about the thickness of parchment. It is then set up in a wooden frame, and allowed to remain there for several days, the slope of its position being gradually increased, till the amalgam is sufficiently hardened to adhere so firmly as not to be removed by slight scratches, after which the plate is finished and fit for framing. It is a considerable time before the amalgam gets perfectly hard, so that globules of mercury are frequently

detached from the surface of the glass or by any concussion of the air.

It often happens in mixing glass, that there is too great a flux admitted into the composition; this is not generally the fault of the mixers, as it is not possible to be always a judge of the strength of the fluxes. But if the fire is well kept up, and the draft of the furnace properly regulated, it will take a far less portion of flux to form glass, than with an indifferent fire. A good fire is also the best agent for depriving it of gall or sandover, but if there is too great a quantity of it on the glass, the practice is in Europe, to put on two or three shovels full of broken glass, taking care to hold the glass long enough in the furnace, before it is dropped into the pot, for if it is dropped in cold or moist, it will make the sandover fly with a loud report, and often covers the person not acquainted with its quality, with a hot liquid substance which on cooling assumes a very white colour. When there is too much of it on the glass, it is taken off with a small ladle previously heated for fear of explosion. The general practice of the German and French glass makers is to burn it off, but this method is very destructive to furnaces, for as they commonly use open pots, the glass gall flows over and being of a very penetrating nature corrodes both the pots and furnace as far as it reaches, acting as a powerful flux on sand stone and brick.

If on the contrary there is not a sufficiency of alkali in the composition, or that from the badness of the fire, it cannot sufficiently act in vitrifying the sand, it becomes what is called set in the pots. The only remedy known for this casualty, is to reflux the glass, by having a sufficient quantity of nitre and arsenic prepared, and tied in many folds of paper, plunged into the pot of glass, and stirred about in it; these substances introduce themselves through the whole mass, and revive the former flux, while, at the same time, they destroy any green tinge communicated by iron, or purple communicated by an over dose of manganese: this operation is called squaring. If this process is not attended with success, the only course to be pursued, is to ladle out the glass into water, and re-fill the pot.

JEWELLERS' SECRETS.

To imitate fine Oriental Pearls.

TAKE of thrice distilled vinegar, two pounds; Venice turpentine, one pound; mix them together, and put them into a cucurbit; fit a head and receiver to it; and after you have luted the joints, set it, when dry, on a sand furnace to distil the vinegar from it; do not give it too much heat lest the stuff should swell up. After this put the vinegar into another cucurbit, in which there is a quantity of seed pearl wrapped in a piece of silk, but so as not to touch the vinegar; put a covered head upon the cucurbit; lute it well, and put it in balneo mariae, where you may let it remain a fortnight. The heat of the balneo will raise the fumes of the vinegar, and they will soften the pearls in the silk and bring them to the consistence of paste, which being done, take them out and mould them to what size and shape you please. Your mould must be of silver, gilt on the inside; you must also refrain from touching the paste with your fingers, but use silver gilted utensils, with which fill your moulds; when they are moulded bore them through with a hog's bristle or gold wire, and let them dry a little in a place free from dust; then thread them on a golden wire, and put them in a glass, close it up and set them in the sun to dry; when thoroughly dry, put them in a glass matrass, into a stream of water, and leave them there twenty days, in which time they will contract the natural hardness and solidity of pearls. Then take them out of the matrass and hang them in mercury water, where they will moisten, swell, and assume their oriental beauty. After which shift them into a matrass, hermetically sealed to prevent the entrance of water, and let it down into a well for eight days. Upon drawing up the matrass and taking out the pearls, you will have such as can with difficulty be distinguished from oriental ones

Mercury water is thus prepared:—Take Cornwal tin, and calcine it, and let the calx be pure and fine;

then, with one ounce of the calx and two ounces of prepared mercury, make an amalgam; wash it with fair water till the water runs off insipid and clear; then dry the amalgam thoroughly; put it into a matrass over a furnace, giving it such a heat as is requisite for sublimation; when the matter is well sublimed, take off the matrass and let it cool; take out the sublimate and add one ounce of Venice turpentine, grind it together on a marble slab; put the whole then into another matrass, close it and set it upside down in a pail of water; and the whole mass will dissolve itself in a little time into mercury water. This done, filter it into a glass receiver, set it on a gentle ash fire to coagulate, and it will turn into a crystaline substance: this beat in a glass mortar to fine powder, then sifted through a fine sieve and put into a matrass, stopped close up and placed in balneo mariae: there let it remain till it dissolves again into water, which is the mercury water fit for the above use.

To form large Pearls out of small ones.

Take mercurial water 14 ounces, put 2 ounces of sulp solis into a low matrass, pour the mercurial water upon it and let it dissolve and extract; then take of the whitest small pearls 20 ounces, put them into a proper matrass, and pour the said water on; the pearls will by degrees dissolve, and at last turn to a clear calx, much like dissolved silver calx; pour off the mercurial water, boil the calx well out and dry it; then put it into a clean crucible by itself, and melt and cast it into what form you please; when cold polish it in the same manner as you would gems or crystals, and you will have work of the consistence and beauty of oriental pearls.

Choice secrets for imitating precious Stones or forming artificial Gems.

To make a fair Emerald.—Take of natural crystal 4 ounces, verdigris 48 grains, crocus martus, prepared with vinegar, 8 grains: let the whole be finely pulverized and sifted, put all together into a crucible, leaving an inch empty, lute it well and put it into a potter's

furnace, and let it remain there for the space of one kiln fire. When cold break the crucible, and you will find the matter of a fine emerald colour, which, after it is cut and set in gold, will surpass in beauty an oriental emerald. If you find that the matter is not refined or purified enough, put it again into the same furnace, and in lifting off the cover you will see the matter shining; you may then break the crucible, but not before, for if you should put the matter into another crucible the paste would become cloudy and full of blisters. If a potter's furnace is not at hand, build a small one yourself, sufficient to contain 10 or 12 crucibles, each with a different colour, which ought to stand in the furnace from twenty-four to thirty-six hours.

To make Paste for imitating Oriental Pearls.

The colour of this stone is like water tinged with saffron or rhubarb. To imitate it take prepared natural crystal one ounce, of red lead seven ounces, finely powdered and seared: mix the whole together, and put it into a crucible, not quite full by an inch, lest the matter should run over or stick to the cover of the crucible whilst in ebullition. Then proceed as before directed.

To make an artificial Crysolite.

This stone is of a green colour, and some have the cast of gold; to imitate which take natural crystal prepared 2 ounces; red lead 8 ounces, crocus martus 12 grains: mix the whole finely together, and proceed as before, only leaving it a little longer in the furnace.

Another process for imitating precious Stones.

Take of black flint stones what quantity you please, and put them into a pail of hot water, and then put them into a hot oven; this will prevent their flying into pieces; or else warm them thoroughly by degrees, until they are at a red heat, when take them out and quench them in cold water, and they will look of a fine white colour; dry and pulverize them very finely; this may

be done in an iron mortar; but as it may contract some of the iron, it will be proper after you take it out, to pour on it some aqua fortis, which will clear it of the iron, and so disengage it from all filth and impurities; then wash it in several hot waters.

This powder, thus prepared, is fit to be used for making the finest glass, and for imitating the clearest and most transparent glass, and gems, especially those that require the lustre of the diamond or ruby. As for sapphire, emerald, topaz, crysolite, or amethyst, &c. your labor with aqua fortis may be saved, if your mortar be bright, and free from rust. Such as have a mortar of porphyry, or such like stone, have no occasion to use an iron one. In case black flints cannot be procured white river pebbles will answer the purpose.

A secret to make a Diamond of natural Crystal.

Take the best polished crystal, no matter whether small or large, so it be but clear and transparent; put it into a crucible with three times as much fixed sulphur of gold, so that the crystal may be covered all over with it; then, after having luted a lid to the crucible, let it anneal for three days and three nights in a hot fire; then take it out and quench it in spring water in which hot steel has been quenched about forty times, and you will have a diamond which resembles a natural one in every respect, and is as good.

How to make a Diamond out of a Sapphire.

Fill an earthen pipkin or crucible with quick lime, and lay the sapphire in the midst thereof, covering it first with a tile, and then with coals all over, blowing them gently until you have a clear fire, for if it is increased too soon, the stone will break. The sapphire will require from 5 to 6 hours fire; if the blue colour is not then gone, keep it in the fire longer. This is the art whereby inferior precious stones are changed into diamonds—they are afterwards cut in the middle, and a colour given them: from hence comes the second sort of false diamonds or doublets.

A plain direction concerning the polishing natural and counterfeit gems.

It is to be observed that all glass or artificial stones may be cut and polished after one method, namely, by strewing fine powdered emery upon a leaden plate, moistened with water, holding the stone firm and grinding it into what form you please. If you throw ground tripoli upon a pewter plate, and throw a little copper ashes among it, it will have the same effect. Pulverized antimony, strewed upon a smooth plate of lead, with tripoli and vinegar, polishes not only glass, crystal, garnets, calcedons, agates, and amethysts, but all natural stones except the diamond. The diamond can only be cut with diamond powder itself Any such diamonds which can be touched with emery, lead, copper, or other metals, or to be cut therewith, are false; and this is a good test to know a real diamond.

The method of counter drawing, on artificial Gems, the original Camieos, Intaglio's, and other Gems, which are kept and preserved in the several Museums in Europe.

Choose the finest sort of tripoli which can possibly be found, grind it on a marble into an impalpable powder, and as subtle as possible, add a little water so as to make it into paste; then put it into a small square tin mould with turned up edges, press well your paste into it, and smoothen the surface, and as soon as you see it begins to dry, stamp on it the seal of which you want to obtain the impression; and taking it off carefully from the tripoli paste, let the paste dry thorougnly. When you find that it is perfectly hard, and that the strokes of the seal are solid, put on the impression some powder of crystal, or any artificial stone you please, whether red, green, blue, or any other colour; then, with a metal pipe, blow on that powder the flame of a candle or lamp till the crystal is perfectly melted; when done lay something, such as a small iron pallet, of nearly the size of the seal, on the melted paste, and press it gen-

to make it take the better impression and all the turns of the design, and then let it cool; when you take the crystal up you will find it to be a perfect design or copy of the original. You may then send it to the lapidary to be cut and set, for ring or seal as you please. From these very copies you may even get others by following the same process of operation.

When you have made on the tripoli paste the impression of the original seal, the safest and shortest way would be to bake it in a furnace, under a tin arch, to prevent the coals from touching the impression, which might hurt and damage the relief; then take off the tin mould, and having put on the crystal powder or other fusible matter, you may place it again under the same arch in the furnace, and when that powder is melted, do as before directed.

VARIOUS RECEIPTS.

Gilding Leather.

LEATHER is gilded either with leaf brass or silver, but most commonly by the latter, in which case a gold coloured varnish is laid over the metal.

Tin foil is used instead of silver leaf for the less perfect kind of gilding.

To gild Brass or Silver.

Take 2 ounces of gum lac, 2 ounces of yellow amber, 40 grains of dragon's blood, in tears, half a drachm of saffron, and 40 ounces of good spirits of wine: infuse till the whole is well incorporated, and then strain it through a linen cloth. The piece of silver or brass must be heated before the varnish is applied, and it will then assume a gold colour, which will bear cleaning with a little warm water when soiled.

Cold Solder, for Iron, Steel, or Pot Metal.

Take crude sal ammoniac, pulverize it fine, and mix it with olive oil to the consistence of cream; then make whatever is to be united bright and clean, and anoint the parts that are to be united with the above composition; then dip them into melted block tin, or if it is an instrument such as a file or the like, put the two ends together and hold them straight, and apply the melted block tin, of a blue heat, all round the broken parts, and they will be welded strong.

To remove the outer scale from Iron or Steel and render it White.

Take pot or pearl ashes 3 oz. common salt 3 oz. moisten them with chamber ley to the consistence of molasses; cover your iron or steel all over, when

brought to a cherry red then put it in fair water, and it will scale as white as silver.

Another.

Take salts ammoniac, pulverized fine, mix it with an equal quantity of quick lime; put them all together in a little cold water, and mix well; take any iron piece which you have made red hot, put it in the prepared water, and it will become white.

INKS.

In speaking of inks, I shall not attempt to give all the receipts which might be selected, but choose from among them such as appear to be most worthy of attention.

Black Ink.

Put into a stone or glass bottle 3 ounces of finely powdered galls, one ounce of clean copperas, one ounce of logwood, finely rasped or shaved, one ounce of gum Arabic, and a quart of soft water: shake the bottle well, and let it stand in a moderately warm place for a week or ten days, shaking it several times each day. It is then fit for use, and ought to be shaken before it is poured into the inkstand.

If the ink is wanted for immediate use, the galls and logwood may be boiled about an hour, adding a little more for waste in boiling, and strained while hot, and the other materials then put in, and the ink will be fit for use in a few minutes.

If white wine or vinegar be used instead of water, the ink will be very fine.

It is said that a few cloves put into ink, will keep it from moulding.

An indestructible Ink.

Boil one ounce of pernambuco and three ounces of nut galls in 46 ounces of water, down to 32 ounces in

alk. Pour this while hot upon half an ounce of sulphate of iron or martial vitriol, one quarter of an ounce of gum Arabic, and one quarter of an ounce of white sugar. After these are dissolved, add one ounce and a quarter of finely pulverized indigo, and three quarters of an ounce of lamp black, or of smoke black, previously diluted in one ounce of good brandy.

An Ink to Mark on Linen.

Beat up an eleven penny bit of silver, and put it in a phial with two teaspoons full of aqua fortis and one of water. Put the phial, stopped, into boiling water till the silver begins to dissolve; after which apply no more heat till near the end of the operation to dissolve the gum. When the silver is dissolved [there must be as much as the liquid will dissolve] pour off the solution from the sediment, and put in it the size of a pepper corn of gum Arabic, and put it in the water to dissolve the gum. Then fill a 4 ounce phial nearly full of water and put in the size of a nutmeg of pearl ash and six pepper corns in size of gum Arabic. When the linen is to be written on, first wet it with this pearl ash solution, then dry it, and write on it with the silver solution and dry it, after which wash and expose it to the sun.

A cheap and excellent domestic Ink.

Take as much bark of young maple tree (at a time when the sap does not run) as when cut into small bits will make a bulk about equal to one gallon: put it into an iron kettle which will hold about 2 gallons, and pour on 1½ gallon of rain water, and let it boil moderately for about three hours, (keeping on as much water as will cover the bark;) after which take out the bark and boil slowly till reduced to about a quart; then put in the size of two large nutmegs of clean copperas, pulverized, and let it simmer a few minutes; after which take it off, strain it through flannel, and put in a bottle, cork it up, and it will be immediately fit for use when cool. If a small portion of chesnut and white oak bark be mixed with the maple, the ink will be the better, and

increase in blackness as it grows older. The vessel should be covered while boiling to keep out the dust and ashes which would injure the ink.

Ink made in this manner possesses several advantages: It is the cheapest that can be made, as the articles can be had without any expense, and if the ingredients be duly proportioned and carefully attended to, the ink will be equal to that made of gall nuts, &c. and may be made of as deep a jet black as any Indian ink for drawing; but if *too much* copperas is used, it will turn yellow on the paper after a few months. It is known to stand good on paper without changing its colour for more than 20 years when well made.

China or Indian Ink.

Burn some lamp black in a crucible till the fume ceases to rise; grind it next on porphyry or marble, with a pretty strong water of gum tragacanth, add an equal quantity of indigo, burnt and ground in the same manner. Then mix the two together, and grind them on the stone for 2 or three hours. Gather up the composition into a kind of flat cake, which you may cut through into long slips or sticks, and then squeeze them in a mould made for the purpose, the inside of which has been previously rubbed over with ivory black or dust of burnt peach stones, to prevent the paste from sticking to the mould. This should be done for every slip that is pressed, and when moulded in this manner they may be laid by to dry. It should be dissolved in water in which a little gum Arabic has been dissolved, when you wish to use it.

Printers' Ink.

Printers' ink is made in the following manner:—Ten or twelve gallons of nut oil are set over the fire in a large iron pot and made to boil. It is then stirred with an iron ladle, and whilst boiling the inflammable vapor arising from it either takes fire or is kindled and suffered to burn about half an hour, the pot being partly covered to regulate the flame, and consequently the

heat communicated to the oil. It is frequently stirred that the whole may be heated regularly. The flame is then extinguished by entirely covering the pot. The oil by this process has much of its unctious quality destroyed, and is rendered of the consistence of turpentine when cold, and is now called *varnish*. After this it is made into ink by mixture of the requisite quantity of lamp black, of which about 2½ ounces are sufficient for 16 ounces of the prepared oil. Some other articles are thrown in during the boiling, the more effectually to destroy the unctious quality of the oil, such as crusts of bread, onions sliced, and sometimes turpentine, and some others which are kept a secret by those who make the ink.

To make Stucco, or an Ink to mark on Stones, and which will stand against water.

Mix together the kind of lamp black made by burning linseed oil with black pitch, and dissolve all together over a slow fire. This is very suitable to be put in letters or inscriptions cut in tomb-stones, &c.

Red Ink.

Boil 2 ounces of Brazil wood in a pint of water for 15 minutes, and then add a little gum Arabic, and about half as much alum. Some add a little madder to the composition.

Red ink may also be made by dissolving the cakes of common water colours in gum water, as vermilion for scarlet red, and fine lake for lighter red, or even a mixture of them for an intermediate colour.

Yellow Ink

Is prepared by dissolving a little alum and gum Arabic in pure water, and then infusing a sufficient quantity of saffron in the solution—Or,

Boil 2 ounces of Avignon seed or French berries in a quart of water, down to two-thirds of a quart, having half an ounce of alum in the water. It should boil

slowly, and then 2 drachms of gum Arabic, 1 of sugar, and 1 of pulverized alum added.

Dissolve gamboge or king's yellow in gum water; in like manner any of the common water colours may be used for ink of their respective tints.

Ink Powder.

Take 10 ounces of gall nuts, 3 of Roman vitriol or green copperas, 2 of alum and 2 of gum Arabic: make the whole into a fine powder, and when mixed with white wine or vinegar, it will quickly become black and be a good ink.

An Ink Ball.

Boil fresh maple bark in rain water, down to a very strong ooze, and then to each quart of the liquid put near half an ounce of clean copperas powdered, and boil a few minutes. This is a very good ink, and may be evaporated away to the consistence of wax, and formed into balls, which may be again dissolved in water for use.

To make excellent Crayon Pencils.

Take fine grained charcoal, say of maple or some other smooth wood, and saw it into slips of a proper size for the pencils, and put them into a pipkin of boiling beeswax for ½ or ¾ of an hour, and when cool they are fit for use. A little rosin mixed with the wax will make them harder, and a little tallow or butter softer than the wax alone.

These pencils write well, and the marks are almost as permanent as those made with ink, and less liable to be affected by dampness.

To preserve Cherries and other Fruit without Sugar.

Fill a bottle quite full of ripe cherries, and cork it loosely; set it in a kettle of cold water, and kindle a fire

under it so that it will increase in warmth very slowly, and bring it to about 170° (or near to boiling) in about three-fourths of an hour, and let it continue at that heat for about half an hour longer. Then take out the bottle, uncork it, and fill it up among the fruit with boiling water; after which cork it tight and lay it away on the side in a safe place until wanted for use.

To make Mead.

Honey 68 lbs. water 17 gallons, whites of 12 eggs, beat up with a quart of the honey and water while cold. Boil the whole 1 hour, skimming often. Then pour the boiling liquor on the rinds of 1 dozen of Seville oranges, and cover it up. When only lukewarm add the juice of 100 oranges, and 6 lemons with their rinds. Stir the whole well, and cover it till cooled down to 96° of Fahrenheit; then put in a pint of good ale yeast in which a piece of toasted bread has been previously dropped. When it has fermented sufficiently (say 2 or 3 days) strain it off into clean casks, when it may stand six months, and then be bottled. It should be drawn off carefully, so as not to disturb the grounds.

To Gild Paper.

Take yellow ochre and grind it with rain water, and lay a ground of it all over the paper to be gilded. When dry, beat up the white of eggs with white sugar candy, and strike it over the ochred surface of the paper; then lay on leaf gold, and when dry polish with a tooth.

PAINTING, &c.

An excellent Composition to preserve Wood.

Melt 12 oz resin in an iron kettle; add 3 gallons of train oil, and 3 or 4 rolls of brimstone. When they are melted and become thin, add as much Spanish brown, or any other colour you choose, ground up with oil in the usual way, as will give the colour you desire. Then lay on a thin coat with a brush, and when dry lay on another.

This will preserve gate posts, weather boards, shingles, &c. &c. many years from the effects of the weather, and will prevent the rain from injuring brick walls.

Another Composition.

Three parts slacked lime, two parts wood ashes, and one of fine sand, or stone coal ashes: sift the whole through a fine sieve, and add as much linseed oil as to make it of a proper consistence to work with a brush: lay on two coats, the first thin, the second as thick as will work with a brush. The ingredients must be perfectly mixed, and will preserve wood, &c. many years. This is a very cheap composition.

A celebrated White Paint for Fine Work.

To a gallon of spirits of turpentine add 2 pounds of frankincense. Let them simmer over a clear fire till dissolved; then strain and bottle it for use. To a gallon of bleached linseed oil add a quart of the above, and bottle it up also. Let any quantity of white lead be ground up fine with spirits of turpentine; then add to it as much of the second mixture as will make it of a consistence to work well; if it becomes too thick, add a little spirits of turpentine. This is called a dead white; it will dry and cease to smell in six hours, and is a most beautiful paint for fine inside work; but is too expensive for common use.

To render Old Pictures as Fine as New.

Boil in a pipkin for fifteen minutes, ¼ lb. of grey, or birl ash, and a little Genoa soap. When it is only luke warm, wash the old picture with it, and then wipe it. Pass some olive oil over it and wipe it off again. It will be as fine as new.

A Wash to Clean Pictures.

A ley of clear water and wood ashes; dip a sponge in this and pass it lightly over the picture. Chamber ley, or white wine will answer the same purpose.

Red Sealing Wax.

Take 2 parts shell lac, 1 of resin and 1 of vermilion, all reduced to fine powder, and melted over a moderate fire till well incorporated, after which form it into sticks.

Sud lac and boiled Venice turpentine may be substituted for the shell lac and resin.

A coarser kind is made of equal parts of resin and shell lac, with equal parts of vermilion and red lead, in proportion of two parts of the latter to one of the former articles, and proceed as above.

Black Sealing Wax.

Shell or sud lac, melted with half its weight of levigated ivory black, and some Venice turpentine are melted as above, and poured on a plate or stone previously oiled, and formed into sticks, and exposed to the heat till they assume a glossy appearance.

Soft uncoloured Sealing Wax

Is made of 1 lb. beeswax, 3 oz. turpentine, and 1 oz olive oil; one ounce of any colouring pigment may be added if necessary, and then melted, and formed into cakes for use.

How to take Stains out of Cloth, &c.

Apply a solution of oxalic, lemon, or tartareous acids in water. This will remove ink from paper, or from the most delicate fabrics without injuring them.

Lemon juice, or the juice of sorrel will also remove ink, but not so completely as the citric acid or concrete acid of lemons.

Put the size of a walnut of potash, and one lemon cut to pieces, in a quart of spring water. Let it stand 24 hours, and then pour off the clear liquid and bottle it for use. This will remove all spots from cloth. The cloth should be washed in fair water after the spots are removed.

The true spirit of salt will remove iron marks from linen.

Sal ammoniac, with lime, will remove the stains made by wine, &c.

To remove Iron Stains.

Apply the citric acid, or diluted muriatic acid.

If the stains have been long standing, then apply a solution of alkaline sulphuret, which must be well washed out, and then a liquid acid applied.

Fruit Stains

May be removed by a watery solution of oxiginated muriatic acid, or by that of oxiginated muriate of potash, or lime, to which a little sulphuric acid or oil of vitriol has been added; but these can only be used on white articles, as they would also remove the printed colour of calicoes, &c.

Grease Spots

May be removed by a diluted solution of potash; but it must be used with caution to prevent injury to the cloth.

White Wax or White Paint

May be removed by spirits of turpentine or sulphuric ether.

To take Grease Spots from Books or Paper.

Dip a small brush in the essential oil of turpentine, heated almost to ebullition, and draw it gently over both sides of the greased paper, which must be kept warm. This must be repeated as often as the quantity of grease or thickness of the paper may require. After the grease is removed, the paper is restored to its proper state as follows: Dip another brush in highly rectified spirit of wine, and pass it over the paper until it assumes its original whiteness. This operation will not

affect the written or printed letters of the book although it should pass over them.

To make Wafers.

Take fine flour and mix it with the white of eggs, isinglass, and a little yeast; mingle and beat the whole well together and make the batter thin with gum water; then spread it thin and even on tin plates to dry in a stove; after which they may be cut out with a suitable instrument for use

They may be coloured by mixing with the batter a little vermilion or brazil for red, a little indigo for blue, &c.

To Brown Gun Barrels.

Make the barrel perfectly clean and bright; then rub on it some aqua fortis and spirit of salt diluted with water, and lay it by a week or more to form a coat of rust; then rub over a little oil, and after rubbing it off, polish with a hard brush and a little bees wax.

Another Method.

Have the barrel clean as above; then lay a piece of brimstone on some burning coal, and hold the barrel over its smoke, turning it regularly, that all parts may be evenly smoked, and lay it in a damp place 12 or 15 hours, when it will be covered with a fine efflorescence, which wipe off with a woollen rag, and oil and polish as above, or polish with soft fine wood instead of a brush.

Colouring and Perfuming Gloves and Skins.

It is customary, in colouring fine leather gloves, to sew them up at the end, before they are dipped in the colouring matter, to prevent the dye from colouring the inside.

Gloves and skins are coloured yellow by an infusion of saffron leaves; red by brazil wood, vermilion, &c. a pale filbert by a mixture of burnt umber, yellow, white

and red; gold colour by yellow and a little red; straw colour by yellow, a little white and red, with much gum, &c. &c.

To Perfume Gloves, &c.

For this nothing more is necessary than to drop into a small box in which you keep your gloves, a little bergamot, or lavender, or any sweet smelling essence which may be agreeable.

PERFUMES, &c.

To make a Smelling Bottle.

Take equal quantities of sal ammoniac and unslacked lime: pound them separately and mix them in a phial in which you have previously put 3 or 4 drops of essence of bergamot, and 2 or 3 of ether.

Milk of Roses.

To a pint of rose water add 1 ounce of oil of almonds and then 10 drops of oil of tartar.

Rose Water.

To a peck of clean rose leaves put a quart of water, and distil it off very slowly; then bottle it, and in 2 or 3 days cork the bottle well.

Otto of Roses.

X Put clean rose leaves in a glazed earthen vessel, and pour on as much clean spring water as will cover the leaves. If this be set in the sun shine in the morning and taken into the house at sun set, for from 2 to 6 or 8 days, the oil will be on the top of the water, and may be taken up with cotton, and squeezed into a phial.

Otto, or Ottar of Roses, (another method.)

Distil slowly the leaves and cups of roses in their weight of water till half is run off, which is set away to cool in broad shallow vessels of earthen or tin, when the oil will rise on the surface of the distilled water, and may be taken off as before directed.

A cheap and excellent Cosmetic.

Take one quarter of a pound of soft soap, melt it with a gallon of sweet oil over the fire, and add two or three table spoonfulls of fine white sand, and stir it well together till it cools.

A wash for the Skin.

Put 4 ounces of pot ash, 4 ounces of rose water, 2 ounces of brandy, and 2 ounces of lemon juice, into 2 quarts of water, and when you wash put a table spoonfull of this mixture into the water which you use for washing.

To make the celebrated Pomade Divine.

Beef marrow 12 ounces, steeped in water ten days, and afterwards in rose water 24 hours, flowers of benjamin, pounded storax, and Florentine orris, each half an ounce, cinnamon ⅓ of an ounce, cloves and nutmegs ¼ of an ounce. The whole to be put into an earthen vessel, closely covered down to keep in the fumes, and being suspended in boiling water three hours, after which the whole is to be strained and put in bottles.

A celebrated French Wash for the face, &c.

Take equal parts of the seed of melons and pumpkins, gourd and cucumbers; reduce all to a powder; add to it fresh cream, sufficient to dilute the powder; beat the whole together, adding a little milk if necessary, to make it of the consistence of an ointment. Put this on the face for half an hour, and then wash it off with warm water.

On the Transmutation of Metals.

To transmute silver into gold, take a new iron pan, make it red hot upon a trivit, and then put 2 pounds of lead into it. As soon as this is melted throw over it by degrees some good salt petre, pulverized, and this will melt likewise; keep it thus in fusion till it is at least half dissipated; should it take fire during that time, it will do no harm, and the more concocted over again the salt petre is, the stronger the oil. Let this cool; divide the salt petre from the lead; after having well pounded it on a marble stone, carry it into the cellar; there it will fall into a deliquium, which you will pour into a cucurbit; with double its weight of good French spirit of wine, and by little and little at a time; then distil by a slow fire, grind on marble as before what remains in the cucurbit, and being turned into deliquium, put it again into the cucurbit with some more spirits of wine; take off these dissolutions and cohobations, repeating the same process over again as before till the salt petre remains at the bottom of the cucurbit resolved into a true oil which congeals itself no longer, and this will procure you what is called the fixed balm.

Next to that operation you will make an aqua fortis with equal parts of salt petre, dried vitriol, and rock alum; and before you put the receiver to the cucurbit, add steel filings, antimony, verdigris, in subtile powder, tutty, and cinnabar, of each half an ounce, according to the quantity of aqua fortis you want to draw; cohobate the spirits seven times over upon the faeces, which you will grind each time on a marble table. Dissolve one ounce of silver in three of this liquor, and on that solution still drop by drop one ounce of your nitre oil in a bottle made like the hour glasses, which after the operations must be at most only half full; which you will cover with another inverted, so that the neck of the under one should get into that of the upper one, or else put it in a matrass with a long neck, which you will seal hermetically; but if you make use of bottles, take care to lute the joints; place this over hot ashes, and plunge it in them to the height of six inches, give under this

lamp fire, which should not reach the matter by three fingers distance; you get every day to the amount of a silver penny weight of silver fined into gold, and when the whole shall have been fined thus, day after day, the aqua fortis, which before was green as an emerald, will become as clear as pump water; let the composition cool, and divide the water from the oil, which will never be the worse for use, and must therefore be preserved. At the bottom of the vessel you will find the silver fined into gold.

Permutation of Lead into Silver.

Take fine lead, calcine it with common salt, soak the whole warmly with oil of vitriol till you make it come into an unctious paste; this you will put into a pot or crucible, well luted, and placed in a pan full of sand, with which you will cover it over entirely; make under this a digesting fire, that is to say, such a fire as is necessary to warm the sand: keep it so for ten days; then take off your matter and test it; out of one hundred and five pounds of lead, you will draw two pounds and a half weight of silver, capable to stand the test.

Transmutation of Iron into Copper.

Iron is easily changed into copper by means of vitriol. To do this, you must put your iron, stratum super stratum, in a desensorium, and set it over a strong blast fire, pushed by bellows till the iron melts and flows into copper. You must not forget when you have made beds of vitriol, to water them a little over with vinegar, saturated of salt petre, alkaline, and tartar salts and verdigris.

Potatoes made use of for cleansing Linen, Cottons, &c.

Take as many potatoes as may be necessary at one time; wash them clean and boil them; drain the water from them and mash them; after which mix them with fresh boiling water to the consistence of gruel, in which

immerse the dirty clothes, and let them remain covered with the mixture for twenty four hours; then rub the clothes out of it, and rinse them thoroughly in cold water and dry them, when they will be completely cleansed. Potatoes used as above directed, entirely remove grease and every kind of dirt from white or coloured linen or cotton clothes; and in preparing thread linen or yarn for the weaver, they supersede the necessity of using soap or pot ashes, or of boiling the yarn, of which every person may be satisfied who will take the trouble of trying the experiment.

Method of rendering Hats Water-Proof.

Take a thin plate or shell, made of wool, hair and fine beaver, to form the crown of the hat, and another plate of the same materials for the brim. These parts may be dyed black and finished without glue or other stiffening, in order that they may not be injured by the rain, which in other beaver hats, after being exposed to a heavy shower of rain, draws out the glue, which sticks down the nap, and makes it appear old and greasy. The plate may be made in one piece only, in the shape of the hat, blacked deep enough to admit of the brim cut from the crown. The under side of the plate and the inside of the crown must then be made water-proof by first laying on a coat of size or thin paste strong enough to bear a coat of copal varnish, and when thoroughly dry, another coat of boiled linseed oil; when dry, the crown must be put on a block, and a woollen or cotton body, or shape wove on purpose, put into the inside of the crown, and cemented in. When dry, it must be finished with a hot iron, and the crown is done. The brim must in like manner be cemented to a substance or body made of woollen or other fine materials sufficiently thick to make the inside of the brim. The brim and the body are now to be pressed together, after which the under side of the brim may be covered with another plate of the beaver or with shag The cement used for sticking the parts together may be made with one pound of gum senegal, one pound of starch, one pound of glue, and one ounce of beeswax boiled in

about one quart of water. Hats made in this way only require to be wiped dry after being exposed to the heaviest shower.

To clean Oil Paintings.

If smoked or very dirty, take stale urine in which a little common salt is dissolved; rub them over with a woollen cloth, dipped in that till you think them quite clean; then with a sponge wash them over with fair water; then dry them and rub them over with a clean cloth.

To remove spots of Grease from Paper.

Take an equal quantity of rock alum, burnt, and flour of brimstone, finely powdered, together; wet the paper a little, and put a small quantity of the powder on the place, rubbing it gently with your finger, and the spot will disappear.

Thunder Powder.

Three parts of good dry salt petre, two parts of salts of tartar, and pound them well together; then add more than one part of flour of brimstone; mix the whole perfectly together, and put the composition in a phial well corked for use; take two drachms of the composition and put it in an iron pan, and put it over the fire, but not in the blaze. In a short time it will melt and go off like a cannon or thunder.

A good Varnish for Great Coats or Umbrellas, and other articles exposed to the weather, by which they are rendered both sun and rain-proof.

Boil well together 2 pounds of turpentine, 1 pound of litharge in powder, and 2 or 3 pounds of linseed oil. When the article is brushed over with this varnish, it must be dried in the sun, after which the greatest rains will not affect it.

To render Cloth Water-Proof.

Take one ounce of melted white wax, add one quart of turpentine; when well mixed and cold dip in your cloth and hang it up to dry.

To Clarify Quills.

Scrape off the outside film, and cut the ends off; then put the barrels into boiling water, wherein is a small quantity of alum and salt; let them remain in a quarter of an hour, and then dry them in a hot pan of sand or in the oven.

FRUIT TREES.

MANY conjectures have long been afloat respecting the cause of the destruction of the fruit trees, particularly those of the peach and plum. Some have ascribed it to a worm in the root—others, to an epidemic, and affirmed, that when one tree was infected, the disorder was communicated to others. A late writer, who long held a different opinion, has now become fully satisfied that the evil originates from the sting of an insect commonly called a Beetle, evidently of the coleoptera tribe. This insect is about the size of a large pale bean, of a dark brown colour. Millions of them have this season appeared, and are found in spading up gardens and ploughing. Early in the morning they shelter themselves about three inches under ground, where they continue in a kind of torpid state until night, when they crawl out, take wing, and buz among the branches of the trees like a swarm of bees. They feed on the leaves and sting the tender branches of the trees, which sting is so poisonous as to affect the juices of the whole tree, and cause the leaves to turn yellow and die.

GRAZING,

Being a subject of much importance to the American farmers, I have thought proper to devote a few pages to its improvement. The practice of feeding and pasturing down grass-lands with different sorts of stock, with the intention of improving and rendering them fit for the market, can be carried on to much advantage in most of the United States; but there are tracts of grazing ground, of more or less extent, in most of them; though it may be remarked that, there are certain situations, as well as descriptions of pasture ground on which this method of farming may be had recourse to with better profits and more success than that of any branch of the dairying system. This must

be the case in all those districts where the proportion of land in the state of tillage is very small in comparison to that of the pasture kind; consequently the price of the produce of the grass sort is trifling in comparison to that of the fat stock. In all sections of the United States where the grass lands are so fine and rich as to be capable of fattening large bullocks, or other cattle, this system may be had recourse to with much success and profit, and is, perhaps, the best application to which the lands can be applied, as is fully shown by such districts being mostly under some management of this nature.

Stocking land with proper cattle is one of the nicest parts of the science of farming. Where nature is left to herself, she always produces animals suitable to her vegetation, from the smallest sheep on the Welsh mountains, to the largest sort in the Lincolnshire marshes; from the little hardy bullock on the northern Highlands to the largest ox in the richest pastures of Somersetshire. But good husbandry admits of our increasing the value of the one in proportion to that of the other. Land improved enables us to keep a better sort of stock, which shews the double return the earth makes for any judicious attention or labor we bestow upon it. The true wisdom of the occupier is best shewn in preserving a due equilibrium between this improvement of his land and stock. They go hand in hand, and if he neglect the one, he cannot avail himself of the other. It should, therefore, be first considered what kind of cattle or other sorts of stock, will answer the purpose best, on the particular description of land upon which they are to graze; and next, what sorts may pay the most in the consumption of the produce. In general it will probably be found that upon strong fluid pastures of the driest kinds, the large sorts of cattle, with some of the larger breeds of sheep, will be the most suitable. And in case where the grazer breeds his own stock, he will have little difficulty in selecting such of the different kinds as are most adapted to his views; but where the animals are to be purchased in, which must frequently be the case, more care and circumspection will be necessary. It will be proper, though a difficult task, to make a choice of such as have been well kept and are in a thriving condition,

as when they have been stinted in their food and have a contrary appearance, they seldom do so well for the use of the grazier. It will likewise be of advantage to have them from situations in which the lands are inferior in point of richness. It is noticed by some that many farmers have found great advantage by bringing stock from the poorest spots, as they generally thrive most when they come into a richer pasture, like trees which endure transplanting the better for coming from a poor nursery. They endure folding and penning better than sheep which are fed on a more luxuriant soil Those farmers who think that some kind of sheep will not bear penning labor under an error. It is believed that all lean or store sheep are the better for being folded. They are generally more healthy; and when such sheep are put to fatten they thrive much better and faster, as oxen do that have been moderately worked. But where the grazing lands are very moist, sheep are not by any means a sort of stock to be depended upon.

It is necessary to have regard to the qualities of animals, whatever they may be, with the intention of grazing them Those kinds of sheep which have the property of keeping themselves fat, or in tolerably good condition, by the least consumption of food, being constantly preferred, whatever the size or breed may be, as that is a quality of much greater importance to the grazier than that of mere size, considered in an abstract manner. The grazier, who has fine and rich pastures, may choose the largest beasts he can find, provided they are of the right breed and shape; but let him always prefer shape to size, for it will assuredly pay him better.

In respect to what relates to the sort of cattle that may be employed to the greatest advantage under this system, oxen and such heifers as have been spayed, are in general considered by the best informed graziers as the best sort of stock; as besides being more quiet, the latter have not only the property of fattening in a more expeditious manner, but with less consumption of food. They are not, however, so readily provided by the grazier. The ox is of course the most commonly as well as the most extensively employed for the

purpose of the grazier, as having the advantage of being fattened after he has been wrought by the farmer. Cows are often bought in by the farmer for the purpose of fattening; those that are dry or have slipped their calves at an early period, or are become aged; but great caution is necessary in purchasing this kind of stock, for they generally turn out unfavorably, for when old they rarely thrive well or get fat with any degree of expedition. The practice with some graziers is to purchase their cattle in autumn, supporting them through the winter principally with straw, or sometimes, which is a much better practice, with a little hay mixed with it, till the beginning of March, continuing their fattening through that and the succeeding month with some sort of succulent food, such as turnips, potatoes, or other similar kinds, until the grass be in a fit state to be turned upon in May, on which they may be carried forward and completed according to circumstances, about August or in the following month. And others purchase lean beasts as soon as the grass lands are in a fit state to be turned upon, and wholly completing their fattening on the grass about the latter end of the autumn season. In this system of management, the smaller kind of cattle may be found in general the most advantageous, especially where lands are of a less fertile and luxuriant description.

An extract from the Port Folio for fattening Neat Cattle.

There is a way to fatten cattle in absence of the common means, scarcely inferior to the best, as the following instances will prove:—I fatted an ox and a three year old heifer in the winter of 1818, without either corn or potatoes, for less expense than even that of common keeping, by a preparation of cut straw, &c. as follows:—I boiled about two quarts of flax seed and sprinkled it on cut straw which had been previously scalded and seasoned with salt, together with some oil cake and oat meal, working them together in a tub with a short pitchfork till the whole became an oily mush. I fattened the heifer first. She was of the com-

mon size, and in good order to winter. I gave her about three pecks, which she ate voraciously, and in the course of four days when the seed was gone she was visibly altered. I fed her regularly in this way about two months, in which time she had eaten about one bushel of boiled flax seed, with the other ingredients in proportion, when she was butchered. She weighed 584 pounds, 84 lbs. of which was tallow. She would not have sold before fattening for more than 16 dollars. I sold two quarters of her for 18 dollars and 13 cents. She cost me not more than 10 dollars exclusive of the hay she ate, which was chiefly scalded as above On the 1st of February I began with the ox. I fed him about three months, but not altogether as well as I did the heifer. He digested about one pint of boiled flax seed a-day, prepared as above, which I suppose formed half the fat in these two cattle. The ox was short, measured 7 feet 2 inches, and when killed weighed 1082 lbs. and had 180 lbs. of tallow. He cost me while fattening 25 cents a-day; he had previously cost me 35 cents. My net gain in fattening these two cattle was more than I have cleared before in fattening oxen and cows in 15 years, and this is owing, I think, to the use of flax seed. I never fattened cattle that appeared so calm, so hearty, and digested all their fare with so much natural ease and regularity as these. I would therefore recommend the above preparation to the attention of farmers as a good substitute for corn. I kept my cows on it alone in the month of March, for one-third of the expense of hay. It makes rich milk and excellent butter.

On the importance of using Chaff.

The improved chaff-cutter is employed for both hay and straw. The chops or cuttings of both are technically called chaff.

Those who top and blade their Indian corn will find it amply reward them, although in plentiful hay seasons it is not so much an object. Many cut off the whole of the corn plant near to the ground, and dry the ears and stalks in open conical stacks. They will find the straw-

cutter of important advantage for promoting nutritive chaff from the whole plant after the ears are taken off. Cutting even the tops and blades will be more economical than giving them whole. These hints are not theories, but the results of experience Those who are struck with its advantages will have notice in due season to prepare for the execution of the plan suggested. Let them suspend prejudice till they have tried the experiment A powerful straw-cutter is all-essential. Additional labor is no doubt required, but the following extract will shew that the important saving of provender quadruply repays it:—

I have throughout the summer kept my horses in the stable, feeding them with good hay and beans. My oxen have, on the contrary, always been turned out to grass when liberated from their work. They have had the range of good pastures and the benefit of some less valuable hay previous to their going to labor. As the meadows began to fail us toward the end of September, the increased consumption of hay alarmed me, as my four oxen and five horses consumed no less than four tons within one month. This caused me to prohibit its use in the racks and to feed all the cattle with chaff, of which a boy can cut sufficient for daily use in 2 hours.

One hundred weight of hay was found to yield twenty bushels of chaff, pressed into the measure and piled as high as it could safely be carried, consequently each bushel weighed five and a half pounds. It was found that the four oxen and five horses would eat twenty-four bushels of chaff during the twenty-four hours. Ever since they have been fed with chaff only, and have very evidently improved in condition.

Twenty four bushels of chaff amount to about twenty-one tons and a half yearly, which, deducted from forty-eight tons, (the quantity we were consuming in the year,) gives a saving of about twenty-six and a half tons, or more than half. I have, however, carried the retrenchments farther by cutting bean stalks to the extent of about a quarter of the chaff: these being laid uppermost in the cutting-trough, keep the hay well pressed and cause it to cut more regularly. Thus we now use about 2,500 weight of hay monthly, instead of four tons.

How much superior to bean stalks those of our Indian corn will be found, every one acquainted with both can well ascertain, there being no comparison between them. The corn stalk far exceeds in saccharine and nutricious quality; add to this the top blade and husk, and our Indian corn plant as well for its grain as for every part of its substance, must be acknowledged to be the most valuable of Cerelian grain bearing products. It is welcome in seasons of prosperity and plenty, and doubly so in those of scarcity and deficiency of other esculents for ourselves or provender for our stock. How much more economically the very stalks and husks can be expended if brought into our barn yard or sheds for support to our cattle, instead of suffering them to waste and tread them down at their will, dropping their manure to be given to the winds, let any one determine who has been wise enough to make the experiment. If it be even considered as an article to be converted into manure, the corn stalk far exceeds straw or any other such material. How miserably then do they mismanage who suffer their stock to wander in their stalk fields, and wasting as much as they eat, leave the greater part of the offals of the corn plant to perish uselessly and shamefully. The pretext that they are ploughed in for the benefit of the succeeding crop, is idle, as few of the stalks can be perfectly covered, and they have been found unrotted under the ploughing, even when partially covered, after a crop of wheat. The earth checks fermentation in such detached matter, there not being a sufficient body of them together to promote putrefaction when stalks are scattered at random as they fall over the field. Burning them is a wretched substitute for the superior advantages derived from hauling them into the yard in the fall, using what will answer for provender and rotting down the residue for highly valuable manure.

STOCK.

As great caution is requisite in stocking a farm to advantage, I shall make a few remarks upon this subject. All tame animals which are fed in pastures, are,

properly speaking, cattle; but to distinguish the cow kind from others, they are usually called neat cattle.—Of these are various breeds, which appear to be original and distinct, though climates and soils may have done something in producing these varieties. The most obvious of these is the polled breed, or the cattle without horns. Other breeds in that country where, perhaps, the greatest variety is to be found, may be worthy of notice:—

The Original or Wild Race of that country—Color invariably white; horns tipped with black; ends of the ears, inside and outside, redish; flesh fine and well tasted.

The Devonshire Breed—Said to be descended in part from the above race; color light red, with a light dun ring round the eye; thin face; thin skin; hips wide; tail quite low; rather small boned; horns turning upwards. The cows yield good rich milk. Oxen good for draft, and fatten early.

Dutch, or Short-Horned Breed—Hide thin; horns short; tails set high; color red and white, nearly mixed; tender constitutions; fatten well, and yield large quantities both of milk and tallow.

Lancashire Breed—With straighter horns than those of any other, spreading widely and extending forward; large and square built; fore quarters deep; milk not abundant, but rich; the animal hardy. From an intermixture of this breed with others, the Dishly breed was obtained, which are remarkable for fattening very easily, though they yield but little milk or tallow.

Highland Breed, or Kylces—Horns turned upwards; colours various, chiefly black, though sometimes brindled or dun; hair long and close; bodies well shaped; best suited for cold, mountainous countries; good for milk, and inclined to fatten.

Polled Breed, before mentioned—Shaped like the Devonshire breed, though rather shorter; hides moderately thick; hardy, and fatten kindly on the best parts; flesh good and well mixed with fat; oxen good for draft. A variety of this breed of cows, called the "Suffolk Duns," are excellent for the dairy. These are small, lean, big-bellied, and of a dun colour.

Alderney, or French Breed—Small; light red; smooth, neat horn; tender constitutions; rich milkers; flesh good.

Welsh Breed—Chiefly black; small, with thick horns turning upwards; well shaped, vigorous, and well calculated for labor.

Our cattle mostly resemble those of the Devonshire, but evidently we have mixtures of various breeds; so much so, that no specific characters can be given them. We have also the polled breed distinct by itself, though sometimes they are found mixed with others.

Breeds of cattle are much improved by crossing or mixing different kinds together; and it also seems essential that there should be no procreation between animals which are nearly related. Let there be little or no consanguinity between the bull and the cow which is put to him. This seems to be agreeable to the laws of Nature; and, among men, is strongly exemplified in the degeneracy of the race, where the peasantry of some small, secluded districts, constantly intermarry with relatives.

In the improvement of breeds of cattle, a due regard is to be had to the uses for which they are designed Thus if the best milch cows are desired, select from the breeds of those which are known to be the best for that use, that is, admitting the size to be equal, those which yield the most of such cream as makes the best butter. Black cattle are not so remarkable for butter as those of a lighter colour.

A perfect cow should have a broad, smooth forehead; black eyes; large, clean horns; thick skin; large, deep body; strong, muscular thighs; large, white or yellow udder; four long, elastic teats; and a slim tail, together with every token requisite to a bull, allowing for the difference of the sex. They should also be young; for milch kine are not good for breeding after they are twelve; though they will often live much longer if kept well and free from diseases.

At the age of four years, all neat cattle have one circular ring at the root of their horns, and one additional ring yearly thereafter. When, however, they become old, these rings grow indistinct, and no longer separately perceptible.

The diseases of cattle are various; and frequently new and uncommon diseases occur. A farmer informs us, that in the winter of 1812, he lost eleven head of cattle by an unknown disease. The attack was indicated by small protuberances appearing round the neck; and after the beasts were dead, some of these were opened and found to be full of worms or maggots. The remedy is to open the protuberances by an incision and clean the part by a solution of Castile soap, and then anoint the part with British oil. This treatment generally effects a cure. A disorder prevails in the northern parts of New York, termed the "hoof ail." The feet of the cattle appear to become diseased, and then to freeze during the winter. Those which are kept on farms of moist and rich soils, are most liable to this disorder; but such as are fed on sandy loam or gravelly farms, seldom suffer in this way. The most effectual preventive is to feed the cattle with plenty of rich food and keep them well littered in warm stables.

In the spring, cattle which have been poorly kept through the winter, are subject to a wasting of the pith of the horn, called the "horn distemper." It is sometimes in one horn only, and sometimes in both. The indications of the disease are, coldness of the horn, dullness of the eyes, sluggishness, want of appetite, and a disposition to lie down. When the brain is affected the animal will toss its head, groan, and exhibit indications of great pain.

To cure the disease, bore a hole with a small gimblet in the lower side of the horn, about an inch from the head, and the corrupted matter in the horn will run out. If this does not effect a cure, throw warm water into the horn with a syringe, in order to cleanse out the corrupted matter.

Another disease to which poor kept cattle are subject in the spring, is the "tail sickness." In this case the tail becomes hollow and relaxed. The cure is effected by cutting off a small piece of the tail, which will be attended with a small discharge of blood; or when the hollow part is near the end, cut a slit in it, one or two inches long, and this will effect a cure.

The "gripes," or "cholic," is mostly troublesome to young cattle. When attacked with it, they lie down

and rise up incessantly, and keep striking their horns against any object that presents. It is attended either with costiveness or scouring. In the former case they are to be treated with purgatives—in the latter with restringents. To stop the purging give them half a pint of olive oil, sweetened with sugar, or a quart of ale, mixed with a few drops of laudanum, and two or three ounces of oil of sweet almonds. To promote purging give them 5 or 6 drachms of fine Barbadoes aloes, and a half a pint of brandy mixed with 2 quarts of water gruel, in a lukewarm state.

The scouring is known in neat cattle by the frequent discharge of slimy excrement, loss of appetite and flesh, increasing paleness of the eyes, and general debility. The beast should be immediately housed and put to dry food; and this, in the early stages of the disease, will generally effect a cure.

Cattle sometimes become "hoven," as it is termed, owing to eating too much when first turned into good pastures, to swallowing potatoes or other roots without sufficient chewing, and to other causes. The stomach of the animal becomes extended with wind, and if a vent for this cannot be afforded the beast must die.

The usual remedy is to open a hole with a sharp pointed knife, with a blade three or four inches long, between the hips and the short ribs, where the swelling rises highest, and insert a small tube in the orifice till the wind ceases to be troublesome. The wound will soon heal again.

Cattle are sometimes poisoned by eating poisonous plants, or by being bit with mad dogs. In the latter case, if the wounded part be cut away shortly after the bite, and then be kept open for some time, it is perhaps the only effectual remedy. It is believed that any medicine which is very anti-spasmodic, if given plentifully, will counteract the effects of the bite of a mad dog.

OBSERVATIONS ON SHEEP.

[BY LIVINGSTON AND OTHERS.]

In a cold country wool is always a subject of importance to the inhabitants. In the eastern and northern

states of the American union, peculiarly so. For more than six months in the year, it may be considered as forming the chief material of clothing, and during the other six it enters largely into the covering of man. In such a climate, wool, and the garments made from it, will always be in demand.

The quantity of this important article which the wants of the people require, will be constantly increasing. It will be called for as the human race multiplies. Every babe that is brought into the world is a new customer to the woollen draper; and the proudest as well as the meanest of mortals derives the protection of his naked body against the inclement elements, from the sheep.

Heretofore it has been customary for the people of the American states to import from foreign countries the principal part of the woollen cloth that they consumed. Although the sheep lived and thrived well among them, they raised the animal rather for food than for raiment. The carcase was more important in their estimation than the fleece. The other productions of a plentiful land afforded them the means of paying for their imports by remittance abroad; and this system of trade and exchange would have continued for a greater length of time had not a jarring arisen among the nations.

In consequence of commercial misunderstanding between the United States and the countries whence it had been customary to receive their woollen manufactures, it has latterly been more difficult to procure them. With the impediments of free intercourse, there has been an increase of price, and notwithstanding the illicit trade carried on by smugglers, the augmented cost of foreign cloth is a serious consideration to the wearer. Amidst these restrictions on the intercourse of nations, it has been found expedient to begin a woollen manufacture at home. Our diplomatic connexion with France and Spain has been productive of this favorable result. Two gentlemen whom our government had sent to Madrid and Paris, possessed a patriotic enlargement of soul. They looked beyond the etiquette of courts and levees, and made those ceremonies subservient to a fur-

ther and nobler end. Availing themselves of the favorable opinion they had excited by their manner and their talents, they obtained leave to send home a selection of sheep from the best flocks in the two kingdoms. To Livingston and Humphreys, their country is indebted for that breed of sheep which bears the material for the finest fabrics. The first animals of this race were two pair bought in France by Dr. Livingston and sent to New York under the care of one of his own servants, where they arrived in the spring of 1802. Afterwards he obtained permission to ship others, chosen from the highest bred flocks in that kingdom, by permission of the minister of the home department. All these derived their pedigree from the stock given by the Spanish monarchy to Louis XVI, in 1786. Mr. Humphreys obtained his sheep directly from Spain. A numerous flock arrived in good health at New York. The committee appointed to investigate the advantages of introducing the Merino breed into the United States thought it to be their duty, first, to ascertain whether this breed of sheep is superior in intrinsic value to the several species bred among us; and, secondly, whether, if propagated here, they would be likely to retain their original qualities. It is in proof to the committee that this race of sheep is inferior to none in the value of the carcases or in the facility of management. They are healthful and fatten easily in our climate. The superior excellence of their wool is fully attested by comparison and an attentive examination of the fabrics wrought from the fleeces grown in this country. Indeed the well known fact, that the wool of the Merino sheep has been for a long time contended by artists and manufacturers throughout Europe as indispensable to the construction of the finer woollen fabrics, is in itself an incontestible evidence of its superior fineness. Whether sheep of the Merino race, if propagated here, will be likely to retain their original qualities, has appeared to the committee to be the main question of practical importance. Upon this point the committee are not left to doubt or conjecture. The evidence that the wool of the imported Merinos has not deteriorated is conclusive. Gentlemen of the first intelligence and integrity

have attentively watched the progressive state of Col. Humphreys' imported flock, and concur in attesting the facts, that the wool of the original stock retains all its superior value in quality and quantity; that the full blooded progeny produced in this country is in no respect inferior to the stock imported from Spain. Were the proof derived from the observation and experience of respectable citizens, in any degree incomplete, the fact that the Merino race is capable of enduring all the effects of a northern climate, without deterioration, would be apparent from multiplied experiments made in different countries. They have been successfully propagated in Great Britain, France, Holland, Switzerland, Germany, Denmark and Sweden. In these new and various situations, their fleeces, on the experience of many years, have been found augmented in quantity and not diminished in fineness. On this combined view of facts, the committee do not hesitate to express a decided and unanimous opinion that the climate of the northern states is not unfavorable to the propagation of this valuable breed of animals.

The committee deem it necessary to suggest the importance of meliorating our breed of sheep particularly in the article of wool. The opportunities that are now offered of crossing the blood and producing a mixed progeny, as also of preserving and extending the full blooded breed to an unlimited degree, are, in the opinion of the committee, advantages of high importance. The wool of the mixed breed surpasses that of the ordinary sheep of the country in a surprising degree, both in quantity and quality. It is found to be very useful in the hat manufactory, and is eagerly sought for at an advanced price. Its value to the citizens of this state is very great for the domestic fabric of homespun garments.

Many of the citizens of this and other states in the union are convinced of the intrinsic value of this breed; and the legislature of the state of New York, desirous of securing the staple of the woollen manufacture, have considered the extensive spread of the Merino sheep in and over their state, to be of so much importance as to encourage it by assurances of liberal pecuniary advancement from their public treasury.

It is desirable that our country should be stocked with various kinds of sheep, in order to supply itself with the various sorts of cloths. In England they have the Teeswater, the Lincolnshire, and the Dartmoor breeds, which yield fleeces of long coarse wool, weighing on an average from eight to eleven pounds, and the weight of their carcases from twenty-five to thirty pounds. The wool of these sheep, and of the Heath, Exmore, and Berkshire breeds, which are smaller and have coarser wool, is proper for the manufacture of carpets, &c.

The Bakewell, Cartwold, and Romney Marsh breeds have also long wool, but finer, being better fitted for the manufacture of worsted fabrics; and the average weight of their fleeces is from eight to nine pounds; the weight of their carcases is from twenty two to twenty-four pounds.

The Bakewell is an improved breed, and was engrafted upon some of those before mentioned, and are highly esteemed for the fatness of their carcases and for the fine taste of their mutton.

In addition to these the English have various other kinds, besides the Merino, yielding fleeces of short wool of various quantities and qualities, the finest of which are the Dunfaced and Shetland breeds, and the next finest is the Hereford or Ryeland breeds, and the next the South Down. The latter resemble our common sheep, having wool equally fine, and are esteemed next to the Bakewell breed.

Mr. Custis, of Virginia, is raising a new breed, which he calls the Arlington sheep, that yield fleeces of long wool. They are a mixture of the Bakewell breeds with a long wooled Persian ram. He has also the Smith's Island sheep, which are remarkable on account of the largeness and fineness of their fleeces. They are shorn twice a-year, and some of the fleeces weigh four pounds at each shearing.

The Otter sheep, so called on account of the length of their bodies and the shortness of their legs, have wool of an inferior quality.

The Broad-tailed sheep are found in almost every quarter of the globe. They are of different kinds, and

yield fleeces of different qualities in different climates. They are generally larger than the European sheep, and the tails of one kind weigh in many instances fifty pounds, being so weighty that the shepherds are obliged to place two little wheels under the tail to prevent its being dragged on the ground.

The composition of this excresence is said to be a mixture of flesh with a great proportion of fat, and to be very delicate food; but the animal has little other fat, the tail being in him the repository of that fat which lies about the loins of other sheep.

The Cashmere breed, in eastern Asia, surpasses the finest fleeces of Spain for the exquisite delicacy of the wool.

A yearling sheep has at its first shearing two broad teeth before, besides its narrow teeth; when sheared the second time it has four; the third time six, and the fourth time eight; they are then said to be full mouthed. The teeth of ewes begin to decay at the age of five years; those of wethers at seven, and of rams at eight.—At this age a ram should be castrated and turned off to fatten with other old sheep. Ewes will fatten faster during pregnancy than at any other time. Those set apart for fatting should be kept separate on good feed, and have some Indian meal daily. It is said that a sheep is never made very fat but once, and that then is the proper time for killing it; but perhaps this is not founded on truth.

The proper time for shearing is when the weather has set in pretty warm, but sooner where the wool is falling off. The wool of the merino sheep must be washed after shearing, as it cannot be washed to any effect while on their backs. The shearing of these sheep may be later as their wool never falls off. Sheep of the common kind may have their wool washed while on their backs, but in that case they should be kept some days previous to shearing in a clean pasture, in order that their wool may again imbibe some of the oil which is lost by washing, which will render the shearing more easy and require less oil to be afterwards added for spinning.

In shearing care should be taken not to cut them, and this is more particularly necessary with the merino

sheep, whose fleece is so close as to render this operation much more slow and difficult, double the time at least being requisite for shearing one of these that is necessary for one of the common kind. During cold or rainy weather, after shearing, they should be placed where they can go into their place of shelter when they please, as they know best when they want shelter and when they become so warm as to require the open air.

The wool of yearling sheep should be kept by itself, because not having the same texture or strength that the wool of older sheep has, it will make the cloth shrink unequally if mixed with such wool. The other fleeces may be sorted at shearing time, making separate parcels of the thighs, the bellies and the back and sides. Wool should not be kept long without washing, as in that case it is liable to ferment and spoil in hot weather.

Sheep require but little water if they feed when the dew is on the grass, but in winter they should have free access to it. Feeding each with about half a gill of Indian corn per day is very beneficial—it keeps the flock in a thriving condition, it enables the ewes to rear their young much better, and it prevents the wool from falling off in the spring. For early feeding for the ewes which have lambs a field of rye, thickly sown, is very good. Sheep thrive much better by being changed frequently, but those will be most benefitted which are taken from poor pastures and put into better.

Livingston observes that from twenty-nine common sheep, he had upwards of one hundred and fourteen pounds of wool, which he sold for thirty-seven and an half cents per pound. This, allowing one dollar and fifty cents for the expense of keeping each sheep for a year, fell short three cents on each fleece of paying for their keeping.

Eighty-three half blooded ewes gave upwards of three hundred and ninety-three pounds; and forty-seven half blooded wethers gave upwards of two hundred and thirty-six pounds. This wool sold for seventy-five cents per pound: Clear profits on the fleece of each ewe, two dollars and three cents; on the fleece of each wether, two dollars and fifty-five cents.

Thirty-three fourth blooded ewes gave upwards of one hundred and fifty-six pounds, and three wethers of the same blood gave upwards of sixteen pounds. This wool sold for one dollar and twenty-five cents per pound.—Clear profits on the fleece of each ewe, four dollars and seventy cents; on the fleece of each wether, two dollars and twenty-five cents.

Seven full bred ewes gave upwards of thirty-six pounds, and one ram fourteen months old gave upwards of nine pounds. This wool sold for two dollars per pound.—Clear profits on the fleece of each ewe, eight dollars and seventy-five cents; on the ram, seventeen dollars and twenty-five cents. This wool was all sold at the above prices without being washed.

If these sheep be thus profitable for their wool, they are at least as profitable as any others for fattening.

Mr. Young took a merino, weight eighty-four pounds; a half South Down, quarter Bakewell, and quarter Norfolk, weight one hundred and forty-one pounds, and a South Down, weight one hundred and thirty-six pounds; these were fed together a certain length of time and then weighed. The first weighed one hundred pounds, the second one hundred and forty-eight, and the last one hundred and forty-four pounds. Thus the merino gained more than double the quantity of flesh which the other two gained.—He also makes it appear that a merino only eats in proportion to its size.

The diseases of sheep are not so numerous in this country as most others.

The most prevalent among grown sheep are as follows:—

The *scab* appears first by the animal rubbing the part affected, and pulling out the wool in that part with its teeth, or by loose locks of wool rising on its back and shoulders.

The sheep infected must be taken from the flock and put by itself; then take the wool off the part affected, as far as the skin feels hard to the finger; let it be washed with soap suds and rubbed hard with a shoe-brush, so as to cleanse and break the scab. Then anoint it with a decoction of tobacco water, mixed with the

third of ley of wood ashes, as much grease as this ley will dissolve, a small quantity of tar, and about an eighth of the whole mass of the spirits of turpentine. The ointment is to be rubbed on the part affected, and for some little distance round it, at three different times, with an interval of three days after each washing; with timely precautions this will always be found sufficient.

The *Tick* occasions a constant scratching, and proves injurious to the wool.

Cure.—Cause tobacco smoke to be conveyed into every part of the fleece where the ticks are.

HORSES.

The marks of a good horse are: a high neck, full breast, a lively eye, a strong back, stiff dock, full buttocks, ribs reaching near to the hips, and good hoofs.

Mares that are very fat and gross are not so likely to conceive as those that are moderately fat.

A stallion should not cover before he is six years old, nor after he is fifteen. A mare should never be covered before she is three or four years old. About the 1st of June is the proper time to put her to the horse, and every ninth day after till she refuses to take him.—Mares go with foal eleven months and as many days over as they are years old. While with foal they should be housed pretty early in the fall and be well kept till foaling. They should not be rode swiftly, nor put to drawing or carrying burdens, for a month or two before foaling. The smell of a hide newly taken off will make a mare lose her foal. When about to foal they should be kept in a yard by themselves. It is essential that they should give plenty of milk in order that the colts have a good first summer's growth.

Horses should have a dry pasture, and a good shade in it; and for want of water they frequently learn to feed in the night when the dew is on, which renders the grass more nourishing.

Clover, whether green or dry, is considered as one of the most suitable grasses for horses; but if clover hay be fed to them for some time, it produces too great a degree of looseness. Clover and timothy together are therefore the best.

A horse's age may be best ascertained from his teeth: The first year he has only small grinders and

gatherers, of a brightish colour, which are called foal's teeth; the second year he changes his foremost teeth, viz. two above & two below, and they appear browner and bigger than the rest; the third year he changes the teeth next these, leaving no apparent foal's teeth before, but two above and two below, which are all bright and small; the fourth year he changes the teeth next these, and leaves only one foal's tooth above and one below on each side; the fifth year his foremost teeth are all changed, and the tushes on each side are complete, and those which succeed the last foal's teeth are hollow, with a small black speck in the middle, which is called "the mark in the horse's mouth," and continues till he is eight years old; the sixth year there appears new tushes, near which is visible some young flesh at the bottom of the tush; the tushes being white, small, short and sharp; the seventh year his teeth are at their full growth, and the mark in his mouth appears very plain; at eight all his teeth are plain, full, and smooth, and the black mark just discernible, the tushes looking more yellow than ordinary; the ninth his foremost teeth shew longer, broader, yellower, and fouler than before, the mark quite disappearing, and the tushes bluntish; at ten no holes are found in the inside of the upper tushes, which till then are easily felt; at eleven his teeth are very long, yellow, black, and foul, and stand directly opposite each other; at twelve the teeth of his upper jaw hang over those of his under; at thirteen his tushes are worn almost close to his chaps if he has been rode much, otherwise they will be long, black and foul.

As the horse is subject to many diseases, this work would be imperfect without making some remarks respecting them.

Anticor is a dangerous disease, proceeding from a fulness or inflammation of the blood, occasioned by high feeding without exercise, or by hard riding. In this disease the corrupt and inflamed blood raises a swelling in the middle of the breast, just against the heart. Upon its first appearance take a large quantity of blood from the palate veins, or, if they be hid, from both sides of the neck; then give to drink diapente with beer, adding an ounce of sugar candy and half an

ounce of molasses to it; anoint the swelling every day with a mixture of basilicon and hog's lard; and when the swelling is soft let out the matter, washing it with copperas water; then heal the sore.

The *Bot Worms* breed in the straight gut, near the fundament. To prevent them, give your horses in the spring and fall one ounce of powdered antimony and three ounces of the flour of brimstone, and at times mix the tea of spicewood with the horses feed, and now and then a pint of flax seed. By this method your horse will be kept healthy and free from botts.

The animal makes signs of this disease by frequently looking behind it and frisking its tail. *Cure*—Give the horse a few doses of linseed oil a pint each time, and it will quickly effect a cure.

Farcin proceeds from different causes, as from unwholesome or high feeding, from hard riding, attended with sudden heats or colds, or from infection. It is a kind of venom or corruption of the blood that appears in form of knots or cords along the veins, or by ulcers; these last are cured with a red hot iron, and the former by bleeding, purging, and proper exercise.

The *Glanders*, or *Horse Distemper*, is accompanied with a discharge of matter from the nostrils and a swelling of the glands under the throat and tongue. In the first stages of this disease its chief seat is in little soft spongy flesh, which is easily dilated by the least influx of blood; but treatment in the second stage is to make use of purges, diaphoretics, and roweling in the breast or hinder parts. In the last stages it is generally incurable. To clear the nostrils, pass fumes of burnt brimstone or leather into the nose of the horse; and after the matter has been discharged, syringe his nostrils with brandy or red wine; afterwards cleanse the ulcerated parts.

Gigs—Little tumors or bladders, filled with matter, in the mouths of horses. The cure is to slit them open and then wash them with salt and vinegar.

Foundering is caused by eating too large a quantity of hard grain at once. The legs and feet become stiffened and sore. The best remedy for this is exercise by riding; and in addition to this let the bits of his bridle be bound round with a rag, into which let as much

human odure be put as it will hold. Put this in his mouth and let him chew it while riding him, and in due season repeat the dose if necessary.

Gravelling is caused by little gravel stones getting in between the hoof and the shoe, which settle to the quick, and fester the part. It is cured by picking out the gravel and drawing the place to the quick, then stopping up the foot with horse grease and hot turpentine.

Galling is occasioned by bruises with the saddle. *Cure*—Rub the swelling with good brandy, laying on a paper soaked in it. If the skin be broken, a mixture of red wine and sallad oil is a good remedy.

The *Haw* is a gristle growing between the nether eyelid and the eye, which, if not extirpated, will put the eye entirely out. It originates from phlegmatic humors, which, falling from the head and uniting together, form at last this infirmity. The cure is as follows: Hold the creature fast, and thrust a needle with a strong thread through the eyelid, and tie it to the mane; then a needle with a long thread must be thrust through the haw, and the skin cut round it with a sharp knife; the haw is plucked out by means of the thread; after which the eye must be cleansed from the blood, and washed with beer with salt dissolved in it.

The *Casting of the Hoof* arises from some prick, foundering, surbating, &c. which causes an imposthumation in the foot, whereby the hoof, and sometimes the coffin bone, being spungy, falls off in large pieces.

Hoof loosened.—If the parting be round about the coronet, caused by foundering; if in part, then by a prick, quitter bone, gravelling, &c.

Hoof swelled.—This befals young horses, when wrought hard, which makes the hoof swell by reason of the blood falling down and settling there, and if not speedily removed begets a wet spavin

The *Brittle Hoof.*—The hoof in this distemper cracks and flakes off on every slight occasion.

The cure in these several disorders of the hoof is as follows: Take bee's wax, refined turpentine, suet, and hog's lard, of each four ounces; sallad oil a quarter of a pint, and a half a pound of dog's grease; let the whole be melted together and strained through a piece of can-

vass into a gallipot. Anoint the hoof well with this twice every day, especially at the roo'; and if there are any large cracks, they must be filled up at every dressing with a mixture of equal parts of cow's dung and hog's lard.

The *Lampas* is a swelling in the roof of a horse's mouth, which hinders him from feeding Young horses are most liable to it. A cure may be effected by applying a hot iron to the swollen part, and afterwards anointing the place with olive oil.

The *Spavin* is a disease of which there are four kinds. Two of them are seated on the inside at the bottom of the ham; the other two on the inside of the hoof, under the joint. The two former are called the ox and dry spavin, and the two latter the wet and the boney spavin. The ox spavin is a callous tumor, hard as a bone, and very painful. The dry spavin is more easily perceived by the horse's raising the leg with a twitch higher than the other. The blood spavin is a soft tumor which grows through the hoof, and is usually full of bloody matter. The bone spavin is a crusty substance, growing on the inside of the hoof, under the joint. The ox and dry spavin is occasioned by a kick or hurt, and the blood and bone spavin by some infirmity in the hoof. The method of curing it is by blistering the part; but if there is blood or other matter, you may apply restringents and a bandage tightly drawn round the part. Should this fail of cure, you may make an incision into the bag and let the matter discharge, and dress the part with lint dipped in British oil every day until a cure is effected.

Staggers.—The method of cure is to take a quart of blood from the neck, drench him well with flax seed oil, and likewise give him one ounce of the tincture of assafœtida every six hours for twenty-four hours. If no relief, bleed again, which method will often cure the worst stages of the disease.

Wind Galls.—The method of cure is to open the swelling about half an inch and press out the matter, and apply the decoction of bark to the wound and bandage it up very tight, and a cure will be effected in a short time.

Rowelling of Horses—Is a method of cure frequent-

ly had recourse to in inward strains or hard swellings not easily removed.

Splent is a callous, hard, insensible swelling which breeds on or adheres to the shank bone of the horse; it oftentimes grows very large so as to spoil the shape of the leg. The best remedy is blistering and the application of mercurial ointment.

Fistula When the horse is first attacked a cure will be easily effected by bleeding, roweling and physicking; likewise the horse must be kept from heating his blood and apply cider oil as hot as it can be borne every 12 hours. If the ulcer is formed the part should be laid open and the matter discharged and the wound cleansed with a solution of castile soap, the part anointed with tar and seneca oil, half and half, applied about blood warm, when a cure will be soon effected.

The *Pollevil*—The cure is effected in the same way as the fistula above described.

Farcy—A cure is effected by bleeding and purging, and turning him on fresh pasture.

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